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ON
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No. 44.

ACUTE RHEUMATISM
in Children in its relation to
HEART DISEASE.



MINISTRY OF HEALTH.

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PREFATORY NOTE BY THE CHIEF MEDICAL OFFICER.

To the Right Hon. NEVILLE CHAMBERLAIN, M.P.,
Minister of Health.

SIR,

(1) I beg to present a Report embodying studies in the bacteriology, incidence and institutional treatment of acute rheumatism (or of what may perhaps more correctly be termed acute rheumatic infection) in children, considered in relation to the prevention of heart disease. These studies include a summary of the present position of the bacteriology of acute rheumatism by Dr. Eastwood, of the bacteriological staff of the Ministry of Health, a special study by Mrs. M. Forest Smith of cases of rheumatic infection in children living in their own homes and treated as out-patients in St. Thomas's Hospital, and a section dealing with treatment in special residential schools and other institutions by Dr. J. E. A. Underwood, of the medical department of the Board of Education. Dr. J. Alison Glover, a medical officer of the Ministry, is responsible for the remainder of the Report.

(2) The national importance of rheumatism cannot be doubted. It is, in its various forms, one of the most insidious, disabling and mortal of all the great diseases. In a previous Report upon the "Incidence of Rheumatic Diseases,"* the prevalence of acute and sub-acute rheumatism amongst insured persons (all of whom were above the age of 16) was studied, together with the incidence of those other diseases distantly related to acute rheumatism, and commonly, though unfortunately, termed "rheumatic," fibrositis and the various forms of chronic arthritis. I now submit a second Report on Acute Rheumatic Fever in Children, and it is proposed in due course to issue a third statement on the treatment of chronic arthritis.

The gravity of acute rheumatic fever in children lies in two facts. First, it is a serious illness in itself, which entirely disables the child; and secondly, it tends to produce permanent injury to the heart, which may terminate life prematurely or produce life-long invalidity. It is only by the early, continuous and thorough treatment of this infection that we can hope to save life or prevent crippling. There is, perhaps, no more striking example of the importance of dealing with the beginnings of disease—a point to which attention has been drawn in my official medical reports to the Ministry and to the Board of Education for many years past. There are several cardinal principles involved in the science and art of Preventive Medicine; but in regard to treatment of disease the essential consideration in

* Reports on Public Health and Medical Subjects, No. 23. "The Incidence of Rheumatic Diseases," 1924.

almost every malady is to begin at the beginning. Whether it be poliomyelitis, or venereal disease, or diphtheria, or tuberculosis, or cancer, or acute rheumatism, the most potent factor in effective treatment is to commence as promptly as possible after the first signs have manifested themselves.

Partly by a process akin to that of denudation in geology, that is by a reduction of the general mortality, the great peak of heart mortality stands out each year more boldly than before. It is becoming steadily more prominent. In 1926, of every 1,000 deaths in England and Wales, 142 were ascribed to heart disease, and if other diseases of the circulatory system be added, the figure is 188. In other words, no less than 85,200 deaths occurred last year which were attributed to this cause. Here are the five principal contributors to the mortality-tax in England and Wales in 1926, per 1,000 deaths :—

1. Disease of the Heart and Circulation	188
2. Bronchitis, pneumonia and other respiratory diseases ..	149
3. Cancer of all forms	117
4. Disease of Nervous System	102
5. Tuberculosis	82

It is clear therefore that heart disease has a pre-eminence among “the captains of the men of Death,” and its relative, if not its real, mortality is steadily rising. Much of this heart mortality is, as we should expect, concentrated upon the age groups of later life and of old age, for much of it is due to degenerative processes and to senile changes, to the wearing out, in short, of pumping machinery incessantly at work, a wearing-out which may perhaps be hastened or deferred, but which cannot in the end be averted. But even if we assumed that half the total heart mortality be accounted for by processes of senile decay, it nevertheless means that the other half of this mortality, which falls upon childhood, adolescence, young adult life, and early middle age, and some of that of later middle age, is due to infective processes such as acute rheumatic fever. These infective processes are caused by diverse organisms, such as the various pyogenic organisms causing infective endocarditis, or those causing diphtheria, scarlet fever, syphilis, or influenza. The most important, however, of these infective sources of cardiac disease and death is probably the rheumatic infection. To this may be due some 40 per cent. of the total cardiac mortality, and even a higher proportion of those cardiac deaths which are due directly to infective causes.

If we turn from mortality statistics to study the sickness records we find that of all patients in hospital with cardiac disease, the cause is definitely acute rheumatism in approximately 90 per cent. of those who are under ten years of age, in 80 per cent. of those between ten and twenty, in 60 or 70 per cent. of those between twenty and forty years of age. After the age of forty syphilis becomes an appreciable factor, and the proportion of cardiac disease of unknown origin increases. After fifty years of age the degenerative diseases such as arterio-sclerosis, Bright’s

disease and senility (all of them often exacerbated by septic infection) begin to approximate to, and then to surpass, rheumatic infection as a cause of cardiac disease and death. Practically speaking every death from heart disease under the age of forty (save the few due to congenital disease) is due directly to rheumatic infection—all those unfortunate cases of adolescents and of young adults, of fathers and of mothers of young families.

The number of children who receive in-patient treatment for acute rheumatism, chorea, and rheumatic carditis is estimated to exceed 2,000 per annum in London alone. Of these more than half undergo in-patient treatment in the various poor law infirmaries of the metropolis, the actual number of children under the age of 16 admitted to the metropolitan infirmaries during 1926 being 1,029. The second report of the sub-committee of the British Medical Association on Rheumatic Heart Disease in Children states that "The voluntary hospitals in general, and the children's hospitals in particular, make every effort to provide in-patient treatment for patients with active rheumatic symptoms, and their needs are fairly well met. Where enough accommodation is wanting it is usually a matter of either particularly heavy incidence or a general shortage of hospital beds for the district."* In view of the estimates recorded in Section VI of the present report and of the data furnished by Mrs. Forest Smith this statement by the Sub-Committee is, I fear, too favourable. Even children suffering from the acute stages cannot be adequately dealt with by the voluntary hospitals on account of the shortage of beds. Only a very small proportion of these 1,029 children in the Metropolitan poor law infirmaries had been passed on from general or children's hospitals. Dr. Bruce, the Medical Superintendent of Southwark Poor Law Hospital, says: "most cases are admitted from their homes; it is most exceptional for a case of acute rheumatism to be referred here from a general hospital." It is unfortunate that, owing to the pressure upon beds, the children who are admitted to general and children's voluntary hospitals cannot be retained long enough to ensure a sufficient period of convalescence to prevent relapse or heart involvement. Further, many children are removed from the poor law infirmaries by their parents before they are really fit to be discharged; nor, of course, are these institutions particularly suited to long periods of convalescence.

For every child who is fortunate enough to be admitted as an in-patient there are two, three or even four children who need in-patient treatment, and who do not get it. They have to be treated, somehow or other, in their homes. Mrs. Forest Smith shows simply yet cogently the disadvantageous conditions under which the average child out-patient with rheumatism or chorea labours, and how impossible it is for such a child to obtain the rest and control he needs in a crowded, busy, restless home.

* British Medical Journal, April 16th, 1927 (Supplement, p. 125), Appendix to Report of Sub-Committee.

What, then, is the nature of this insidious infection? Is the infecting organism of one specific kind? or is acute rheumatism, like septicaemia or food poisoning, a diseased condition which can be produced by an association of organisms or by more than one specific bacterium? If the *causa causans* be single, is it an infection of purely streptococcal origin? If so, is it a highly specialised strain of streptococcus of the *viridans* group? If not, and if the streptococcus be only a secondary invader, what is the primary invader? Is it a filter-passer? If it be a filter-passer, is not its comparatively low grade of infectivity exceptional for infective viruses of this type? If, again, the infection be due to a streptococcus of the *viridans* group, why do the salicylates, which are not known to be selectively antibacterial for these organisms, have an action so nearly specific upon the arthritic form of the disease—an action unparalleled in any other streptococcal infection?

That we should be driven to ask ourselves a series of questions like this indicates the degree of our ignorance as to the aetiology of this wide-spread infection. Dr. Eastwood's analysis of the many attempts to give consistent answers to these difficult questions properly occupies a primary place in this Report, for a clear knowledge of the causal agent would probably lead us to the essentials of preventive action. The present position seems to be that:—

- (a) we have no certain knowledge of the causal agent of this infection, although the theory that a streptococcus of the *viridans* group is the bacteriological agent, without being fully proven, provisionally holds the field:
- (b) no rival theory has so far made substantial headway:
- (c) attempts to identify rheumatic strains by serological methods have failed:
- (d) further work is urgently needed, especially on blood cultures and including the elaborate methods of combined chemical and serological analysis which have been employed in connection with pneumococci.

Whilst the bacteriologists are exploring the field and continuing their investigations, the *predisposing conditions of infection* are being studied. There is good ground for believing that the social condition and environment of the patient is a potent influence. This social aspect of the disease has recently received the attention of the Medical Research Council, and their report appeared but a few weeks ago, in March, 1927.* In his introduction, Dr. Still shows how much more common is the disease in hospital practice than in private practice, mentioning that in 1,000 consecutive children under 10 years of age seen at the Children's Out-patient Department at King's College Hospital, 229 children (or 13·1 per cent.) showed evidence of acute

* Medical Research Council. Special Report Series, No. 114, Report of Committee on Child Life Investigations, "Social Conditions and Acute Rheumatism," 1927.

rheumatism, whilst on the other hand in 700 consecutive children between 6 and 10 seen in a private practice dealing almost exclusively with the well-to-do, only 0·7 per cent. showed evidence of rheumatism. Such a large difference can hardly be accidental. In view of the heavy incidence of rheumatism upon children of the hospital class as compared with that upon children of the wealthier classes it might be expected that the incidence of rheumatism amongst the former would be in direct relation to the degree of poverty. This, however, was found not to be the case; indeed, if the hospital patients are divided into three classes according to the degree of poverty, the poorest of these three, the destitute, show a lower incidence of rheumatism than the other two.

In the investigation itself there was found to be clear evidence of family incidence, rheumatism was common in the parents or brothers and sisters of the rheumatic child. "This might indicate inheritance of the disease or of some special tendency to the disease," similarity of environment or possibly contagion. No sufficient evidence of heredity was forthcoming. Inquiry was made into the home conditions as regards general management, maternal care, exposure to cold and damp, clothing, sleeping accommodation, cleanliness, distance from school, and the occupation and health of the parents, and their income. Housing conditions were investigated with reference to locality and dampness, the number of rooms per family, the cleanliness, ventilation and sanitary accommodation.

A comparison between the rheumatic and non-rheumatic children in respect of these conditions seemed to show that in the rheumatic families the maternal care was less good, and therewith exposure to cold and wet was more common and clothing less satisfactory. There was no evidence of any special frequency of verminous conditions in the rheumatic families, a point of some interest in view of the possibility of conveyance of infection by such means. The housing inquiry threw but little light on the problem. Dampness, popularly associated with "rheumatism" in general, and sometimes supposed to take a large part in the causation of rheumatic fever, was only slightly more frequent in the homes of the rheumatic families than in those of the others. Overcrowding of rooms did not seem to be commoner amongst the rheumatic families than amongst the controls. Nor was there any appreciable difference, in London, between the two as regards sanitation, although in Glasgow the proportion of rheumatic families living in houses with bad sanitation was substantially higher. Neither ventilation nor lighting appeared to be any worse in the homes of the rheumatic families than in those of the controls. "It will be seen," says Dr. Still, "that the findings are largely negative."

The Committee's observation that the very poor and destitute show a lower incidence of rheumatism than do the children of the hospital class coincides with previous observations made by such experienced physicians as Hutchison in London, Thomson

in Birmingham, Coates and Thomas in Bath, and Morrison in Bristol. Nevertheless the observations must, I think, be accepted with considerable reserve. Mrs. Forest Smith's findings submitted in the present Report suggest that the poorer the home the greater the risk; many observers, especially in the United States, have emphasised the influence of mal-nutrition upon the production of heart disease, whilst in this country the observations of Cardale for the London County Council in 1911 showed the high incidence of heart defects, and of acute and subacute rheumatism in necessitous, neglected, poorly clad, children in the Isle of Dogs and Homerton*.

Practitioners of preventive medicine turn, as I have said, more and more to the beginnings of disease. From heart disease they revert to acute rheumatism; from the study of frank rheumatic fever or obvious chorea, they move in search of those premonitory symptoms of the rheumatic infection, such as growing pains and recurrent tonsillitis, which, in children, may be the forerunners either of an acute attack of arthritis or chorea, or else of an otherwise unheralded carditis. This report, therefore, reversing the usual order, discusses the incidence of the premonitory symptoms or the so-called "minor" manifestations of the rheumatic infection upon the child population before considering the attack-rates of acute rheumatism or the incidence of chorea. The statistics with regard to the incidence of such premonitory symptoms in children attending public elementary schools naturally vary over a wide range, and deductions from such statistics as to how many children should be regarded as being, what the Americans call, "potential cardiacs" must be made with great reserve. Yet it is of importance that parents and teachers should be fully alive to the significance of such manifestations.

Education of the public, and particularly of parents and teachers, concerning the risks and dangers of rheumatic infection, and the meaning of these early signs, forms an integral part of any effective scheme of prevention.

Elsewhere I have set out the principal steps at present available in the routine methods of prevention.† They may be summarized as follows:—

(1) First of all intensive and organised *research* is required. A knowledge of the exact cause of acute rheumatism must be sought for. Bacteriological investigations of the disease and its behaviour must be co-ordinated with clinical and epidemiological inquiries.

(2) *Following-up*.—The School Medical Officer should establish a *register* of all the children suffering from the principal manifestations of acute rheumatism, especially heart disease and chorea. Such children should be individually studied and kept under observation.

(3) *Dissemination of Information*.—Parents and teachers should

* London County Council Medical Officer's Annual Report, 1911, p. 159.

† "An Outline of the Practice of Preventive Medicine," 1926, H.M.S.O. Price 1s. See also "The Health of the School Child," 1926. H.M.S.O. Price 1s. 6d.

be informed of the significance of acute rheumatism and its early symptoms. The dangers of neglecting "growing pains," sore throats, anæmia, the early signs of chorea, etc., should be impressed upon them and steps should be taken to familiarise them with the symptoms which indicate the possible onset of acute rheumatism and with the means which may be taken to guard the child from conditions such as damp rooms, damp boots or clothes, which may predispose to the disease.

(4) The proper nutrition and clothing of the child in attendance at school, and the effective sanitation and dryness of the school premises.

(5) *Exclusion from School*.—Exclusion from school or otherwise of children suffering from the effects of acute rheumatism should be determined by the activity of the disease, the state of the patient, and the conditions of its home life and circumstances.

(6) There should be *medical and surgical treatment* suited to the case, in school, home, clinic, or hospital, and particular care should be taken to remove any focal infection in teeth or tonsils.

(7) The School Medical Officer should also advise in regard to the *home and social environment* of the rheumatic child, its after-care, its upbringing and employment.

(8) Children suffering from acute rheumatism require *early hospital treatment* and there is need for more institutional accommodation for such children. Preferably they should be treated apart from other invalid children and accommodated in separate open-air hospitals or residential *recovery schools*, where "team" and co-operative research can be made into differential diagnosis and causation, and where suitable treatment, training of the body, and education of the mind are available, and where convalescence may be prolonged. Where such hospital accommodation is not available, such children should be kept under regular supervision at the Child Welfare Centre, at the School Clinic or at special Cardiac Clinics. There should be active and close co-operation between such work and the hospital service of the area, and between hospital almoners and Care Committee.

(9) Finally, it must not be forgotten that while acute rheumatism is a disease of childhood and adolescence, its cardiac manifestations are often prolonged into adult life. The prevention and treatment of heart disease in the adult requires, therefore, consideration, planning and systematisation.

The "Residential School of Recovery" for rheumatic children, which I first recommended in my annual report to the Board of Education in 1912, has now at length been recognised as a necessity. The Sub-Committee of the British Medical Association in their first report (4th July, 1926), says that :

"The Sub-Committee wishes to insist that it is necessary for every large city to be provided with the means for the institutional treatment of rheumatic children in the course of which they can receive controlled rest, with plentiful sunlight and fresh air, concurrently with education, over periods of months."

How great is the demand may be seen not only from Mrs. Forest Smith's work in London, but from the fact that Birmingham, with 94 special beds at Baskerville, has constantly a list of over a hundred children waiting for admission. In the treatment of the disease it is evident that the existing machinery is neither suitable nor sufficient.

The Report contains data upon several collateral questions to which I ought briefly to refer. The Special Schools for Physically Defective Children are doing a valuable work for the rheumatic and cardiac children of London, and they must continue to receive those cardiac children whose condition we cannot prevent with our present knowledge. We ought, however, to be able to lessen the proportion (at present one quarter of the total number) of rheumatic and cardiac children in them. The newer methods of treatment by prolonged convalescence in special institutions, by early tonsillectomy, by vigilant after-care are far from perfect and until we lay our "just hands on that golden key" of exact knowledge, we must expect to have many disappointments and failures. In the meantime we must continue to send a certain though diminished number of cardiac children to the special schools.

The Report also examines the question of how far ordinary convalescent homes, open-air day schools, and residential open-air schools can be made to serve the rheumatic child. The open-air day school, though sometimes useful, seems on the whole insufficient for his needs; the regimen of the ordinary convalescent home is too strenuous and too happily energetic; as to how far residential treatment for the rheumatic child in this country should approximate to the full open-air treatment, as provided for tuberculous children, we are still uncertain. The Kurandai Home has obtained excellent results with almost full open-air treatment. This is a matter only to be determined by experiment on a sufficient scale.

On the vexed question of the value of tonsillectomy the report is more positive, perhaps, indeed, in its indications it goes further than the evidence warrants. It is suggested that tonsillectomy, though by no means infallible, is of high prophylactic value, and should be performed as early and as completely as possible. It is believed that many of the failures recorded are due to the operation not having been done early enough or completely enough to prevent systemic infection.

Lastly, it is well we should be reminded that no field of preventive medicine offers larger scope for scientific and social investigation than acute rheumatism. Its elucidation requires team work; yet there is ample room also for individual initiative, industry, and imagination. Not only its bacteriology but every aspect of its distribution, character and prevention is full of half solved problems awaiting the investigator. Its treatment also calls for independence of thought translated into experimental action and observation on a large scale.

I have the honour to be,

Sir,

Your obedient Servant,

GEORGE NEWMAN.

Whitehall,

May, 1927.

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ACUTE RHEUMATISM IN CHILDREN IN ITS RELATION TO HEART DISEASE.

INTRODUCTION.

A Short Summary of the History.

The object of this report is to examine the advisability of further organisation for the supervision, treatment, and after-care of children of the poorer classes suffering or convalescent from the various manifestations of acute rheumatic infection, and especially the provision for them of special institutional accommodation as part, and the most important part, of a forward movement of Preventive Medicine directed against the excessive morbidity and mortality due to heart disease. It may, therefore, be desirable to commence with a chronological summary of the history of the trend of medical knowledge and opinion in relation to this matter. "What matters more than logic, or dialectical cut and thrust," said Morley,* "is history—relation of present to past, leading antecedents, external forces, incidents, and the long tale of consummating circumstances. How often do miscalculations in the statesman, like narrowness and blunder in the historian, spring from the neglect of the pregnant and illuminating truth that deeper than men's opinions are the sentiment and circumstances by which opinion is predetermined." Thus, for the purpose of this report it seems expedient to emphasise the gradual formation of medical and public opinion in favour of the measures proposed than to attempt a complete review of the scientific work upon which that opinion ultimately rests.

It has been customary to say that Guillaume de Baillou (1538-1616, Ballonius) was the first author to use the term "rheumatism," although acute rheumatism described under the name "arthritis" is imperfectly described in the Hippocratic books. Baillou's writings were published posthumously in 1642.

Sydenham in 1683 furnished a clinical description of the disease, distinguishing it from gout, and saying "it is commonest in autumn, chiefly attacking the young." He described the chronic form, and in 1686 described chorea. In 1763 Sauvages, who like Baillou was a Paris graduate, suggested a classification dividing rheumatism into ten categories, the first being acute rheumatism, a striking anticipation of the classification which is now generally approved. In 1776 William Withering of Shropshire discovered the therapeutic action of digitalis upon the diseased heart, the drug being introduced into the Edinburgh Pharmacopeia in 1793. David Pitcairn in 1788 first drew attention to the fact that the heart was often attacked by rheumatic fever, an observation which was attributed to him by Matthew Baillie in 1797. In 1789 Jenner described disease of the heart followed by acute rheumatism,

* Notes on Politics and History, p. 30. Viscount Morley.

illustrating his remarks by dissections. Carditis seems at first only to have included pericarditis, endocarditis being discovered later, some say by Baillie in 1797.

In 1780 subcutaneous nodules on the extensor surfaces in subacute rheumatic infections were described by Haygarth of Manchester*, and confirmed thirty years later by Wells at St. Thomas's Hospital. Scudamore in 1827 divided acute rheumatism into acute and subacute, distinguishing the latter from chronic rheumatism. "There is not," he wrote, "probably a more dangerous form of disease than a sudden seizure of the heart during the inflammatory state of the system in acute rheumatism." In 1831 Bright pointed out the close relationship of chorea to acute rheumatism, and the frequent occurrence of heart murmurs in chorea. In 1836 Jean Baptiste Bouillaud† published his Law of Coincidence between the occurrence of heart disease and acute rheumatism. Sir Thomas Watson‡ in 1843 almost states the modern opinion with regard to acute rheumatism. He lays stress upon the greater liability of the young to cardiac complication in the following words: "One law respecting the connexion between the cardiac and the arthritic symptoms may be stated with confidence, namely, that the *younger* the patient is who suffers acute rheumatism (and I have seen it so early as the third or fourth year) the more likely will he be to have rheumatic carditis. The chance of the combination appears to diminish after puberty as life advances." Watson gives a very high incidence of carditis in rheumatic children. "I have known," he says, "only three persons pass through acute rheumatism with an untouched heart prior to the age of puberty," and he also appears to have observed, what has been subsequently confirmed,§ that second and third attacks are more likely to cause heart disease than the first attack. "I have observed also," he writes, "that when a patient has come under my care who has had repeated attacks of acute rheumatism in him I have generally found reason to believe that some organic affection of the heart was present." He suggests that the seat of the latent infection in patients who have repeated attacks may be the heart. "Probably the disposition to such repetitions of the disease, so remarkable in some individuals, may be kept up by the cardiac complication." He agrees with Latham's opinion, expressed in 1845, that "carditis is incident to all the degrees and all the stages and all the forms of acute rheumatism. It is not more to be looked for when the disease is severe than when it is mild."

It is in Watson's lectures that we get the first suggestion of the period for which it is necessary to keep the patient with acute rheumatism in bed, for he quoted:—"the dictum of the first Dr. Warren, who, when asked what was good for acute rheumatism,

* A Clinical History of Acute Rheumatism.

† Nouvelles Recherches sur le rheumatism articulaire.

‡ Practice of Physic (1848), II, p. 294.

§ See for example Ministry of Health Report No. 23, 1924, "The Incidence of Rheumatic Diseases," page 77,

answered 'six weeks,''' an opinion also held by Osler: "The patients are kept in bed for about six weeks."

In 1864 Hirsch announced his conjecture that rheumatic fever was a specific infective disease,* and in the following year Trousseau described rheumatic sore throat.

In 1876, just one hundred years after the discovery of the cardiac action of digitalis, the treatment of acute rheumatism received enforcement of great value in the publication by Maclagan of his results obtained by the use of salicin derived from willow bark. Almost at the same time Buss and Stricker were using salicylic acid, which had been discovered by Kolbe some years earlier, and in 1877 See introduced the treatment by sodium salicylate. In this year, too, Francis Sibson made what appears to be the first suggestion that a longer and more particular convalescence than Warren's "six weeks" was the way of avoidance of permanent heart damage. Sibson found that a much larger proportion of patients (more than two to one) treated by rest escaped the permanent heart mischief as compared with those allowed free action. "The whole chain of evidence points then, I think, irresistibly to the conclusion that the extent, severity and permanent ill-effects of the endocarditis were much greater in the series of cases that were not rigidly treated by rest than in the series that were so treated."

Garrod† in 1890 emphasised the protean forms which rheumatic infection may assume, and so for the first time pointed out the extreme complexity of the problem which lies before those who would prevent rheumatic heart disease. "If it be once granted," he says, "that an attack of chorea with endocarditis, or an eruption of a cutaneous erythema, may constitute as truly a rheumatic attack as the most severe forms of articular lesions, it is obvious that arthritis must be deposed from the position of the essential rheumatic lesion, and must be looked upon merely as the most constant and conspicuous of the manifestations of the disease." From this time forward it was apparent that we had to deal not merely with frank acute rheumatic fever and chorea, but also with a large number of much less definite clinical conditions, such as tonsillitis, myositis, erythemata, and indefinite "growing pains" from which so many children suffer.

In 1898 Singer claimed that the disease was an attenuated pyaemia due most frequently to a streptococcus. In 1899 Westphal, Wassermann and Malkoff produced non-suppurative polyarthritis in rabbits by inoculation with streptococci isolated from a case of acute rheumatism. In 1900 Poynton and Paine described a diplostreptococcus isolated from pericardial exudates, blood cultures and valve lesions, which they named the "Diplococcus rheumaticus." These last three events are recorded

* Newsholme in his Milroy Lectures of 1895 (Lancet i. p. 664) considered Rheumatic Fever as an acute infectious disease with an epidemic prevalence of irregular periodicity, epidemics usually occurring in years of exceptional drought.

† A Treatise on Rheumatism.

here in chronological sequence, but the reader should refer to Dr. Eastwood's section of this report for the history of the bacteriology of acute rheumatism, and for a discussion of the claims put forward for various organisms as the ultimate bacteriological cause in acute rheumatism. That the streptococcus plays an important rôle can scarcely be questioned, but it still remains unproved that this rôle is other than secondary.

In 1902 Einthoven, following Waller's work on cardiac measurement in 1889, introduced the modern electro-cardiographic method of studying the heart's action, and in the same year Mackenzie published his "Study of the Pulse," based upon the results of his invention the Polygraph.

In 1904 Aschoff published the findings by himself and Towara of fibrous nodes in the neighbourhood of the auriculo-ventricular bundle of His* in cases of rheumatic carditis which have since been recognised as important pathological hall-marks of the disease.

In 1906 the modern method of complete removal of the tonsil (as contrasted with the old method of cutting off by guillotine) was introduced by George Waugh at the Children's Hospital, Great Ormond Street.

Sutherland, in his "Diseases of Children," published in 1907, advocated "prolonged rest in bed six months or longer if necessary and sanatorium treatment for one or two years" for children threatened with rheumatic fever.

In 1907 the Education (Administrative Provisions) Act, 1907, was brought into operation, which by its Section 13. 1(b) laid upon local education authorities the duty of medical inspection of school children and the power to make arrangements as may be sanctioned by the Board of Education for attendance to the health and physical condition of the children educated in Public Elementary Schools. In the same year the medical department of the Board of Education was formed, the first annual report of the Chief Medical Officer being published in 1908, a year which also saw the publication of Mackenzie's "Diseases of the Heart." In 1909 the Chief Medical Officer's Report recommended the special medical supervision of rheumatic or cardiac children. The Annual Report for 1912 (pp. 95-104) contained an important section on heart disease and rheumatism, which included a number of definite recommendations, including that of a "Residential School of Recovery," in which children suffering from heart disease might receive treatment for a prolonged period, their rest and exercise being carefully controlled and every endeavour being made to establish their general health and physical fitness as well as to improve the action of the heart. This treatment, the report goes on to say, is especially needed by children recovering from recent rheumatism which has attacked the heart. At the annual meeting of the British Medical Association in 1913, F. J. Poynton, speaking on affections of the heart in childhood, recommended: "Modification of some of our convalescent

* Described by His in 1893.

homes which could be associated primarily with the large hospitals for special care of children recovering from acute rheumatic carditis and chorea."

In the United States of America concerted effort to grapple with the prevention of rheumatic heart disease seems to have commenced in 1915. In this year W. St. Lawrence began a special clinic at St. Luke's Hospital, New York, with a view to providing continuous supervision for the rheumatic child, especially before puberty. In the same year the Society for the Prevention and Relief of Heart Disease was launched, a society which has since been merged in the New York Tuberculosis and Health Association.

The war years of 1914-1918 in England saw the work upon the soldier's heart by Mackenzie, Lewis, and others which has so greatly added to the knowledge of the heart's action in health and disease.

In July, 1919, the Invalid Children's Aid Association opened the Edgar Lee Home at Willesden for 22 boys with heart disease, a pioneer effort which the same Association followed up in 1924 by opening the Kurandai Home at Hartfield for girls and little boys (3-7) suffering from rheumatic heart disease. In 1921 the Corporation of Birmingham began the conversion of their residential cripple school at Baskerville into a home of recovery for rheumatic children, the first step in a scheme of prevention which is more complete than any other in England.

During 1922 the Ministry of Health, with the voluntary assistance of fifty insurance practitioners, carried out an inquiry into the incidence of rheumatic diseases in a large sample of the insured population, the report upon this investigation being published in 1924, a year which saw also the publication of a monograph on "Rheumatic Heart Disease" by Carey Coombs (the first book to deal directly with rheumatic carditis) and Poynton's Bradshaw Lecture (Royal College of Physicians) on "The Prevention of Acute Rheumatism." In 1923 and 1924 an investigation into the relationship of social and familial conditions to the occurrence of acute rheumatism was carried out by the Child Life Committee of the Medical Research Council, the report, "Social Conditions and Acute Rheumatism," being published in 1927.

In 1925, following a report to the Metropolitan Asylums Board by Pugh on "Rheumatic Infection in Childhood," and a report to the London County Council by Menzies on "Manifestations of Rheumatism in Childhood," the Metropolitan Asylums Board sought the sanction of the Minister of Health to devote one block of their Queen Mary's Children's Hospital at Carshalton to form a special "unit" of 60 beds, where children with their first attack of rheumatic fever, acute endocarditis, or chorea might be received at the earliest possible stage of their disease, remaining six months. Special laboratories have been provided for investigation into the problems of aetiology and immunity. The Minister's sanction was given, and the unit opened in 1926. In the same year, 1926, the Chief Medical Officer of the Ministry of Health, in his annual report, advised especially on the practice

to be adopted with regard to acute rheumatism and the chronic rheumatic diseases, and the British Medical Association (following discussions in 1923 and 1925) published a report on "Rheumatic Heart Disease in Children" the work of Miller and other workers.

The general *notification* of acute rheumatism, as was carried out in Norway during the years 1891–1895, would probably be unprofitable at the present time in this country, but whilst notification of many cases can be obtained through the School Medical Service and from children's and general hospitals, a valid case can be made out for the experimental systematic notification for a definite period of years in selected districts which comply with certain conditions. The chief of these conditions are two :—

- (1) An efficient machinery for investigating the cases notified ; and
- (2) Accommodation available for the institutional treatment of such patients as require it.

It is also essential that the local authority concerned should be a keen and well-organised authority whose housing and other records are properly kept and readily available for use. In Paddington these conditions are in substantial degree fulfilled, and in 1926 at the request of the Metropolitan Borough Council, the Minister of Health made an order making notification of acute rheumatism in persons under 16 residing in the borough compulsorily notifiable, and a "Rheumatism Supervisory Centre" was organised for the borough at the Paddington Green Children's Hospital under R. Miller.

The Metropolitan Asylums Board on April 9th, 1927, decided to extend their Queen Mary's Hospital for Children at Carshalton by building further accommodation for about 350 London children with rheumatic disease, and to meet immediate urgent requirements by setting aside 56 beds at their High Wood Hospital for Children, Brentwood, Essex, for cases of that disease.

On April 16th, 1927, the Sub-Committee of the British Medical Association on Rheumatic Heart Disease in Children published a Second Report on the Prevention and Control of Rheumatic Infection in Children supplementing their Report published in 1926. Further reference to this Report will be found on page 93.

This is a brief summary of the development of medical knowledge and opinion in relation to this whole question. That opinion, dormant as it has appeared, when contrasted with the clamant outcries against tubercle and cancer, is now urging with a growing insistence the need for more effective prevention against rheumatic infection in children, and against the rising tide of heart mortality, of which acute rheumatism is so largely the headspring and the source. Let it be granted that little is yet certainly known as to the cause, the treatment, and the prevention of acute rheumatism, can we say that we are now doing what we know should be done for the rheumatic and the cardiac child ? Is such a child assured of the treatment that medical opinion is practically unanimous

in demanding that he or she should receive, and for that period of six months which medical opinion again is practically unanimous in considering the minimum requisite ?

The "ratio of preventibility" has been defined as that fraction of all deaths which would be postponed if knowledge now existing were actually applied in a reasonable way and to a reasonable extent. That ratio applied to deaths due to rheumatic infection is still no inconsiderable fraction.

PART I.

THE BACTERIOLOGY OF ACUTE RHEUMATISM.

By ARTHUR EASTWOOD, M.D.

The Present Position.

There appears to be a strong feeling amongst clinicians that acute rheumatism is attributable to a parasitic infection, though the nature of the causal organism is still an open question.

From the early days of bacteriological work on the subject, those observers who have reported positive results have generally been in favour of some form of micrococcus. There have been a few advocates of a bacillary agent, amongst whom Achalme is perhaps the most widely quoted; but no bacillus has been able to hold its ground against adverse criticism. At the present day it may be asserted with reasonable safety that the infection, if due to a bacterium, is due to one or other variety of cocci.

During recent years the search for a specific coccus of rheumatic fever has been influenced by work done in other bacteriological fields. Questions of classification into species and sub-species have come to the front and older methods of identification have been considerably modified. Less attention is paid to minor morphological characters; and capacity to ferment particular carbohydrates, whilst still useful for orientation, is not now regarded as sufficiently distinctive to serve as a primary basis for identification. Such characteristics as these do not justify the designation of any particular coccus as "*rheumaticus*." Still more important is the fact, now admitted by the great majority of bacteriologists, that the cocci which have been found associated with acute rheumatism are not a species of their own but must be included within the group of streptococci. The first broad distinction which it is now customary to make with these organisms is determined by growth on a blood medium; a strain which produces haemolysis is termed *haemolyticus*; one which fails to haemolyse but tends to grow in green colonies is called *viridans*. Though bacteriologists occasionally isolate *haemolyticus* from cases of acute rheumatism, it is much more usual to obtain *viridans*. So their main problem is to demonstrate a causal relationship between *Streptococcus viridans* and this disease.

Arrival at this definite objective certainly has one advantage ; it removes the confusion caused by the conflicting nomenclature of former years. But it is not an unmixed blessing. The *viridans* type of streptococcus is very widely distributed and is very frequently found both as a harmless saprophyte and as the causal agent in lesions which have nothing whatever to do with rheumatic fever. The next step, in accordance with the tendencies of the present day, is to exploit serological reactions for the purpose of discovering some immunological response which might distinguish the cocci associated with acute rheumatism from other varieties of *viridans*. Unfortunately these endeavours have not, so far, met with any conspicuous degree of success.

Fuller recognition of the difficult nature of their task has had a sobering effect on the enthusiasts who claim to have discovered the aetiology of acute rheumatism. Whilst still convinced that they have found the true causal agent, they are prepared to admit that there remain difficulties which must be cleared away before their claims are likely to gain universal acceptance. Evidence of this attitude is to be found in a recent article by Coombs and Poynton¹ (1926), whose work on the bacteriology of rheumatism is particularly well known. Their conclusions are :—

“ This report concludes that there is no rival to the streptococcic theory of acute rheumatism. There are, however, certain difficulties about this theory.

I. While many observers have found this micro-organism others have failed to do so.

II. Even when found the rheumatic streptococcus has been difficult to place among the streptococci.

(a) Culturally it is like *S. salivarius* and therefore like the streptococcus usually found in endocarditis lenta.

(b) The reactions excited by it in the living body present difficulties :—

(1) Anatomically the lesions following experimental inoculation resemble, but also differ from, those of human rheumatism.

(2) The biochemical changes consequent on streptococcal infection are not yet understood enough to furnish a basis for grouping.

Reasons are given for thinking that these difficulties do not upset the streptococcal theory of rheumatism.”

It seems to me that the authors strengthen their case very considerably by the sound and impartial manner in which they present the difficulties still remaining to be overcome.

It is true, moreover, that there is no rival theory which has made any substantial headway. But I do not think it is safe to argue that, on this account, judgment must go by default in favour of the streptococcal theory. Every bacteriologist is painfully aware that progress in his science is extremely slow; the plea

that no rival has made out as good a case as his own will not necessarily enable him to escape a verdict of "not proven."

Examination of the present position practically amounts to an analysis of the evidence for and against *Streptococcus viridans*.

The Nature of Current Laboratory Work.

It is best to begin with a concrete example which will enable one to form a mental picture of what is actually going on. Assisted by this, I propose to raise a series of questions which will then serve for detailed discussion.

With this preliminary object in view, I have selected for quotation a recently published article which covers the ground fairly well. It must, of course, be remembered that there are many investigators in this field who are working on more or less similar lines and borrow freely from each other's ideas and results; no one of them claims to be pre-eminently superior to the rest.

B. J. Clawson² (1925) isolated streptococci from 20 cases of "well defined, acute rheumatic fever, rheumatic endocarditis or chorea." Fifteen strains were obtained during life, 13 from the blood and 2 from rheumatic joints. The five post-mortem cultures were made from pericardial exudate, spleen, or blood. The patients were in the second or third decades of life, except one who was only a few days old. The mother had developed acute rheumatic fever a short time before delivery; similar organisms were isolated from the baby's joints and the mother's blood. The joints were involved in all of the 20 cases and the hearts in all but 4. Chorea occurred once.

As the organisms were usually scanty, Clawson took 50 c.c. of blood and incubated the clot in 250 c.c. of dextrose (0.2 per cent.) beef infusion broth with a reaction of pH 7.6. The initial growth was slow. "Rarely was the organism found in the cultures by smear in less than 5 days. The usual time was about 10 days after the beginning of incubation. In one case, the organism was recovered after incubating for nearly a month. It is evident that a higher percentage of positive cultures would be found if examinations were made over longer periods of time." When the smear was positive, the culture was plated on blood agar and colonies were picked for further propagation of the strain.

All the strains except one were classed as *Streptococcus viridans*. The exception was a typical haemolytic streptococcus; it was found in pure culture in relatively large numbers in the pericardial exudate of a child dying during an attack of acute rheumatic fever with pericarditis.

He prepared sera with 10 rheumatic strains and, as controls, with 3 strains isolated from cases of subacute endocarditis. Of the rheumatic strains and sera, 7 were found by agglutination tests to form a homogeneous group. (There is no record of absorption tests.) The remaining three were "heterogeneous," i.e., each serum reacted only with its own strain. Two of the endocarditis strains and sera fell into the same homogeneous group as

the 7 rheumatic strains, *i.e.*, agglutination tests failed to effect any differentiation. The third endocarditis strain produced a serum which agglutinated itself alone. Clawson noted that "all strains in the homogeneous group are mannite fermenters, while those in the heterogeneous group fail to ferment mannite."

In 5 cases, the patient's serum was examined for antibodies. "In 4, agglutinins were found in a dilution of 1:50 or more. In one, they could not be detected. The serum of 3 rheumatic patients agglutinated a streptococcus isolated before death in a case of subacute bacterial endocarditis. This case was found to be typical at necropsy."

For the purpose of studying experimental lesions, he injected 35 rabbits with 12 of his rheumatic strains. Well-marked polyarthritis is mentioned as occurring in two instances and in both of these he recovered from the affected joints large numbers of organisms which were identical with those injected. Endocarditis was found in 13 rabbits. The results were irregular. For example, the same strains produced endocarditis in one or more animals but not in others; all four rabbits inoculated with one strain were negative; another strain, inoculated into 5 rabbits, produced no endocarditis but three of the animals died from septicaemia within two days; and in one, which received injections over a period of 2 months, there was pronounced arthritis. When endocarditis occurred, the lesions, including the myocardial lesions, "were essentially the same as the human rheumatic lesions."

As controls, he injected rabbits with three strains from subacute bacterial endocarditis. Two of these strains produced no lesions; the lesions produced by the third were similar, both to the naked eye and microscopically, to those produced by the rheumatic strains. He suggested that the two conditions might be due to the same agent and might represent different degrees of the same process, *i.e.*, "that subacute bacterial endocarditis may be the stage in which there is a development to the extent of an infected thrombus, while in rheumatic endocarditis there is only a stage of mild valvulitis."

Clawson's investigation, which I have taken as a sample from the recent literature, exemplifies the need of further information on many points of interest. Why have some bacteriologists obtained invariably negative results and some only an occasional positive? Clawson does not state if he had any failures; he certainly seems to have been successful as a rule. To what extent does success depend on cultural technique? What corroboration is there of the view that *haemolyticus* may occasionally be the causal agent? What further evidence is available about the serological classification of strains of *viridans* derived from rheumatic fever? The question of demonstrable antibodies in the serum of patients is also of considerable importance. What is the significance of the comparison between experimental lesions produced by *viridans* and the lesions of human rheumatic fever?

What is the bacteriological relationship between rheumatic fever and endocarditis lenta ?

It is easier to ask such questions as these than to answer them conclusively. In the following discussion they will be taken seriatim as far as possible, but it must be recognised that some of them are closely interconnected.

The Significance of Negative Results.

As *viridans* is a very common organism, it may occasionally find its way into a culture as an accidental contamination. But it is impossible to raise an objection of this sort against the great majority of the positive results which have been obtained by skilled bacteriologists. Whether it is "causal" or merely "concomitant," it must be accepted as proved that the association of *viridans* with acute rheumatism is a fact of importance. Hence it is the negative rather than the positive results which call for explanation.

Occasionally one finds that a statement of negative results proves, on consulting the original article, to be of no bacteriological value. This is a matter of some importance, because such statements are liable to be passed on from writer to writer and soon find their way into the text-books. To take a recent example which is already undergoing "passage," I noticed that Thayer was quoted as reporting a consistently negative series of cases. On turning up his article ³ (1925) I found that it did not contain the up-to-date bacteriological evidence which one would naturally anticipate. Thayer stated that, during the last 35 years, there were 25 cases of endocarditis coming to autopsy "which appeared to be of indisputably pure rheumatic origin without demonstrable complicating bacterial septicaemia." The following is his account of the bacteriological work:—"Bacteriological studies were negative in every case in which they were made. Cultures from the blood during life or at necropsy were made in 18 of the 25 cases. They remained sterile invariably. In the other 7 cases, although no cultures were made, bacterioscopical examinations at the necropsy revealed nothing." He adds:—"Several characteristic instances of acute rheumatic endocarditis were omitted from this series because of terminal streptococcus septicaemia." There are obvious reasons why no bacteriologist can accept this as a negative series. It is not a series at all; all the positives are excluded on the ground of demonstrable septicaemia; so naturally the residue is negative. In 7 out of the 25 cases reported, the bacteriological examination was manifestly incomplete. In the 18 cases where cultures were made, one must remember that the "series" commenced 36 years ago, when bacteriologists did not possess the technique for detecting small numbers of *viridans* in the blood.

A difficulty such as the above is easily eliminated by verification of references. But there remain apparent discrepancies between the results of bacteriologists who are generally accepted

as being equally competent observers. These require some discussion, though I may say at the outset that I am not prepared to offer any categorical explanation.

In the first place, many of the workers who have obtained a substantial proportion of positives stress the importance of technique. Clawson's proportion seems to have been remarkably high; so I will now quote another investigation. In an article on the detection of streptococci in the blood, Freund and Berger⁴ (1924) insisted on the use of liquid media. They placed the clot from 5–10 c.c. of blood in an Erlenmeyer flask containing 50 c.c. of a 10 per cent. horse serum broth. The cultures were incubated usually for 4 to 6 days, a longer period not being often required. Every 24 hours, a few drops were transferred to a blood agar plate. By this means they were able to demonstrate streptococci, in the majority of cases, in 1–2 days. Out of 23 cases of polyarthritis rheumatica they found *viridans* in 14 (7 of which showed clinical signs of heart lesions); in one they obtained both *viridans* and *haemolyticus*; the remaining 8 were negative. These results may be compared with their observations on cases of endocarditis:—Endocarditis lenta (19 cases); *viridans* in 16, both *viridans* and *haemolyticus* in 3. Acute endocarditis (18 cases); *viridans* in 14, *haemolyticus* in 3, one negative (one test only). It may be mentioned that, in polyarthritis rheumatica, the authors regarded the streptococci as secondary invaders.

Investigations in which the findings were mainly or entirely negative require careful handling. Full details of technique are not always given. This is rather unfortunate because one would like to feel assured that the authors' methods were quite as good as those employed by bacteriologists who were more successful. But I am not disposed to emphasise this point. One dislikes the vexatious and somewhat gratuitous style of criticism which suggests that a different technique would have converted some of the negatives into positives. When there is no definite evidence in support of a contrary opinion, it is preferable to assume that a negative result indicated the absence of *viridans* in the material examined.

As an interesting example of negative results I quote from a recent article by C. P. Miller⁵ (1924), who investigated 16 cases of rheumatic fever and attempted to transmit the disease to rabbits and guinea-pigs by injecting blood and other material obtained from his patients. Such material was obtained "either before the patients had received antirheumatic medication, or after a sufficient time following the discontinuance of the treatment for its effect to have disappeared." He also stated that "the blood was withdrawn by venipuncture during the acute febrile state while the polyarthritis was still developing." I am mainly concerned here with the protocol in which he records his examinations of the patients' blood. Cultures from the blood (on a number of occasions varying from 1 to 7) were made from 14 of his cases. Thirteen of these cases, involving 51 cultures, were consistently

negative. From the remaining case he obtained *viridans* on three occasions, though in other instances cultures from this patient's blood or serum were negative. Miller's article is a carefully recorded piece of work and, as his technique was doubtless the same throughout, it may reasonably be argued that his 3 positives from one case serve as a "control" which confirms his 51 negatives from thirteen cases.

The above may be compared with an older piece of work by Swift and Kinsella⁶ (1917). From their description of their technique I think it may be taken for granted that negative results cannot reasonably be attributed to any defect in this respect. They made 85 blood cultures from 58 patients suffering from acute rheumatic fever. Seven cultures were positive, yielding *viridans*. Two of these positives were from the same case. With this exception, "positive cultures were obtained only once in each patient and repetition of the cultures a short time afterwards gave negative results. In three instances the cultures were obtained at the time of an acute pericarditis." They also made 34 joint cultures from 25 patients. These all proved to be sterile. As regards antibodies in the human subject, they stated that "the serums of five patients tested failed to react to their respective streptococci." These results they contrasted with Kinsella's findings, recorded on p. 367 of the same volume, in subacute streptococcal endocarditis. Each of his patients (12 in all) repeatedly yielded a positive blood culture; and all the patients' sera contained antibodies against the homologous organisms. Swift and Kinsella were of opinion that their results did not clear up the question of the relation of non-haemolytic streptococci to acute rheumatism. "From a statistical point of view the small percentage of positive cultures would incline towards the negative side of the question On the other hand a small proportion of positive cultures may simply mean that the streptococci circulate in the blood stream only for short periods, or are rapidly killed off, so that the methods employed are sufficient to demonstrate them only occasionally."

As regards their own results, I think the comments made by Swift and Kinsella are sound and impartial. But, in considering the literature as a whole, it is not easy to decide what is the correct "statistical point of view." This difficulty may be illustrated by two examples. Supporters of the streptococcal theory always quote Herry⁷ (1914), who examined 60 cases and obtained positive blood cultures from the great majority of them, employing a technique which was well designed to detect streptococci when present in only small numbers. It is quite right to claim this as an instance where statistics, based on good technical methods, "incline towards" the positive "side of the question." On the other hand, opponents of this theory naturally include in their negative statistics the findings of W. S. Harrison⁸ (1913), who stated:—"I have made blood cultures in twenty-six cases of acute rheumatism, taking 5 c.c. of blood from a vein and

inoculating it into milk broth, peptone broth, ascitic fluid and other media ; the cultures were incubated at 37°C. at first aerobically and later anaerobically ; in every case I failed to get a growth of *S. rheumaticus* or any other germ." He further remarked that "streptococci were found in two joint fluids out of twenty-seven, but there was no evidence that they were identical with *S. rheumaticus*."

These two instances, when sharply contrasted with each other, serve as an illustration of conflicting statistical evidence. I am certainly not prepared to reject or to disparage either the one statement or the other. But the two need not be regarded as irreconcilable. It is safer to take the position that neither series is, in itself, sufficiently comprehensive to be accepted as a valid statistical proof. On taking a broad view of the positives and negatives recorded by various observers, and after making considerable allowance for the fact that some of the work, particularly some of the earlier work, is not now accepted as being altogether reliable, one gains a strong impression that accumulated statistics leave the matter unsettled and that no useful result can be achieved by attempting to balance the positives against the negatives. Satisfactory interpretation of the negatives is generally impossible ; they may mean complete absence of *viridans* as an infective agent or, as Swift and Kinsella suggest, they may be due to the low viability of this organism when it gains access to the blood stream in small numbers.

Supporters of the *viridans* theory naturally place reliance on the latter explanation, which is certainly plausible.

Experimental Lesions.

There is a temptation to treat this subject as briefly as possible, because the upshot is that the results are inconclusive. It would be futile to weigh against each other statements that lesions have been produced which resemble those of acute rheumatism and statements that experimental lesions, when found, differ from those which occur in the human disease. Equally experienced histologists often disagree on questions of this sort ; one searches for resemblances and finds them ; another is more impressed by appearances which do not tally with his idea of the typical picture. Still, this experimental work is far too important to be ignored. It is based on the sound principle that any organism which is thought to be the cause of a particular human disease must be tested on suitable animals, and every effort must be made to ascertain whether the characters of the infection which it produces experimentally distinguish it from other organisms not associated with the human disease under investigation.

Mention may first be made of a difficulty which has recently attracted some attention. The majority of these experiments are made on rabbits which, of course, are assumed to be perfectly normal to begin with. But what is a "normal" rabbit ? These animals are liable to various minor infections which do not detract

from their healthy appearance during life. Such contingencies assume importance when search is to be made, post mortem, for minute histological lesions. When abnormalities are discovered, it may be difficult to decide whether they are due to the material inoculated or to some spontaneous infection. These considerations induced C. P. Miller⁹ (1924) to make a systematic investigation of the hearts of 34 apparently healthy stock rabbits. In 20 of them he found lesions, which occurred most frequently between the muscle fibres of the papillary muscles and ventricular walls; occasionally they were found beneath the endocardium and epicardium. "In some hearts they were numerous enough to be found in every section, while in others search through a number of sections was necessary to demonstrate their presence. The lesions were never visible to the naked eye." Miller was of the opinion that some of the work on the production of rheumatic endocarditis in rabbits was open to criticism on the ground that the lesions discovered might have been of the same nature as those found in his "normal" rabbits.

This seems the appropriate place to note another possible source of experimental error which, if overlooked, might give colour to the idea that acute rheumatism is caused not by *viridans* but by a filter-passer. Miller, Andrewes and Swift¹⁰ (1924) took blood and joint fluid from patients suffering from rheumatic fever and inoculated this material into the testicles of rabbits, transfers being made from testicle to testicle at varying intervals. In three series a virus was recovered which produced acute orchitis in rabbits, and it was found that this virus could be propagated indefinitely from rabbit to rabbit. But further investigation showed that a virus of identical nature could be recovered from the blood of apparently normal rabbits.

I now come to the consideration of lesions which are generally accepted as being due to the material introduced.

Coombs, Miller and Kettle¹¹ (1912) examined the histology of "experimental rheumatism" produced in rabbits by large intravenous doses of culture. They summarised their results as follows:—"1. Inoculation of rabbits with streptococci recovered from cases of rheumatic infection has provoked arthritis, carditis, and other lesions. 2. Histological examination of these lesions discovers (a) that they are identical with similar changes provoked in rabbits by inoculation with a similar micro-organism in the hands of other investigators; (b) that they include all the phenomena, even the submiliary nodule, found in the rheumatic lesions of man. 3. Such differences as exist between the experimental rheumatic infection and the human variety are accountable for by a difference in the mode of entry of the infective agent in the two conditions."

Leila Jackson¹² (1912) investigated the histology of what she called "experimental 'rheumatic' myocarditis" in rabbits injected with streptococci of non-rheumatic origin. All her strains except two were derived from a milk-borne epidemic of sore throat,

the exceptions being "a streptococcus viridans and a haemolytic streptococcus." With regard to her histological findings she stated:—"In the relative absence of necrosis and of polymorphonuclear leucocytes no less than in the abundance of, and apparently large rôle played by, the large so-called 'endothelial' phagocytic leucocytes, the focal lesions produced in the heart muscles of these rabbits are peculiar. These characteristics are maintained throughout all the varying phases of their development, and they are the features which have been emphasised, especially by Coombs but also by others, as distinctive of the focal lesions in the human heart in rheumatism." She also remarked that "all of the streptococci, except the viridans, produced arthritis in rabbits." Her *viridans* was obtained from the heart valves of a man who had suffered from endocarditis for a long time.

Thalhimer and Rothschild¹³ (1914) commenced by making a study of the nodules of Aschoff in rheumatic fever and came to the conclusion that "in rheumatic myocarditis, foci, termed submiliary nodules of Aschoff, are present which are characteristic of the rheumatic infection." They then proceeded to devote their attention to "experimental focalised myocardial lesions" found in rabbits after intravenous inoculation with streptococci. They used nine different strains of *Streptococcus mitis*; one of these was from the tonsils of a case of phlegmon of the neck; the others were from blood cultures from cases of subacute endocarditis. They also employed five strains of *Streptococcus rheumaticus* and three strains from an epidemic of sore throat. Their results were:—
 "1. *S. mitis* produced focalised myocardial lesions which are identical with those caused by the injection of *S. rheumaticus*, and with those produced by Bracht and Wächter with *S. viridans*.
 2. The lesions differ from those which we produced by injections of streptococci from the Chicago epidemic of sore throat.
 3. The lesions are not identical with Aschoff bodies and are easily differentiated from them. They also differ from the foci produced by Jackson and Coombs, who describe their lesions as being either Aschoff bodies or similar formations."

Cecil¹⁴ (1916) gives the following summary of his experiments.
 "1. Repeated injections into rabbits of non-haemolytic streptococci isolated from human cases of infectious endocarditis or rheumatic fever will produce an acute arthritis in the rabbit similar in most respects to the arthritis of acute rheumatism.
 2. Microscopical sections of the joints show a gradual transition from an acute exudative inflammation to advanced organisation.
 3. Endocarditis and pericarditis occur in a small percentage of cases, and focal lesions in the myocardium consisting of necrosis and the infiltration of cells are frequent. These focal lesions differ considerably from Aschoff's submiliary nodules."

Topley and Weir¹⁵ (1921) discussed the lesions produced in rabbits by inoculation with streptococci derived from cases of acute rheumatism and stated, as the result of their experiments, that "similar lesions may be produced by inoculation with

streptococci obtained from sources quite unconnected with rheumatic infection."

The above examples are fairly representative and I think they suffice to justify the opinion, expressed at the beginning of this section of my report, that the histological evidence is conflicting and inconclusive.

The main fact which emerges, as it seems to me, is that a definite answer may be returned to one question. Does *viridans* from rheumatic fever produce in the rabbit lesions which are clearly distinguishable from rabbit lesions caused by streptococci obtained from other sources? No. This is an important conclusion from the experimental work. It does not invalidate the claim of *viridans* but it helps to clear the ground. There is no use in attempting to push the claims of this organism by this particular method of attack.

I do not think that resemblance or dissimilarity between certain myocardial lesions in the rabbit and Aschoff's nodules can be regarded as a matter of any importance.

Production of either acute or chronic arthritis in the rabbit means nothing. Such conditions may be caused by bacteria, belonging to the streptococcal and to other species, which have no relationship whatever with acute rheumatism.

Serological Analysis of *S. viridans*.

The tendency of the present day is to resort to serological methods for the precise identification of bacterial types. It is therefore natural to enquire whether the strains of *viridans* which are thought to bear a causal relationship to acute rheumatism possess some serological characteristics which will distinguish them from strains not associated with this disease. This is a highly important subject, but perhaps it is not realised in all quarters that it is extremely complicated.

Organisms which are now called *Streptococcus viridans* are very common and are widely distributed. Search has been made—and is still being pursued—for a rational classification of them into types or sub-groups by means of serological analysis of their antigens. Results, so far, are not encouraging; in fact it is not at present clear whether serological identification of these organisms is going to prove of much general utility.

The nature of the difficulties will be readily understood in the light of what is already known about the serological classification of pneumococci. Types I, II and III are reasonably straightforward, but then there is a big residue, called Group IV, the members of which not only differ from the three "fixed" types but are heterogeneous amongst themselves. It is true that a certain amount of sub-grouping is possible within Group IV, but there always remain a number of individualistic strains which will not fall into line. *S. viridans*, collectively, resembles the serological "scrap heap" of pneumococci called Group IV; indeed, the

members of which it is composed seem to be particularly individualistic.

Further difficulties arise owing to the need for discrimination between "group" and "specific" serological reactions. Biochemical analysis has shown that the specific reaction of a virulent Type I pneumococcus is due to its possession of a "specific soluble substance." The same is true for Type II, Type III, and—so far as is known—for each fully equipped (*i.e.*, virulent) strain of the heterogeneous Group IV. These "specific substances," it appears, are chemically different from each other, each being peculiar to its own type, sub-group, or "individualistic" strain. The chemists have also shown that, when the "soluble substance" has been extracted from a mass of pneumococci, there remains a residue of protein nature which seems to be common to all pneumococci and is responsible for "group" reactions within the species as a whole. It seems probable that similar conditions apply to *viridans*, though this organism has not, as yet, been so fully investigated from the biochemical aspect. The matter will be made clearer by a concrete example of the laboratory questions which actually arise.

Rebecca Lancefield¹⁶ (1925) investigated very thoroughly four strains of *S. viridans* which were obtained from blood cultures, two from rheumatic fever patients and two from cases of endocarditis. By elaborate chemical methods, she separated from each strain a soluble specific substance (S), which was probably a complex carbohydrate, and a nucleo-protein residue (P). Rabbits were immunised by intravenous injections of living broth cultures. With the sera thus obtained, it was found that the strains were distinct from each other by ordinary serological tests. Corresponding with these distinctions were equally sharp differences between the S substances; the S obtained from one strain reacted with the serum prepared by that strain but not with the sera prepared by the other strains. As regards the P substances she found:—"A close relationship between nucleoproteins from different strains of *Streptococcus viridans* is suggested by the existence of a certain amount of cross-precipitation and a larger degree of cross-complement fixation. But the occurrence of stronger reactions with homologous nucleoproteins than with heterologous indicates that there is some degree of individual difference in proteins from separate strains." She concluded that "two distinct antibodies are present in the sera for *Streptococcus viridans*; one of high titer implicated in the parallel phenomena of agglutination and precipitation by the soluble specific substance, the other usually of low titer and involved in precipitation by nucleoproteins but probably little, if at all, in agglutination." But by prolonged immunisation with living bacteria she found it possible to produce sera with a high content of antibodies for P as well as for S. She observed that "the specific antibodies were not reactive with proteins but were active with high dilutions of the soluble specific substance and were responsible for

the parallel specific agglutination. Absorption experiments showed that the two antibodies in antibacterial sera were immunologically distinct."

Immunisation experiments were also made with P and with S. With the latter substance, the attempt to produce antibodies in a rabbit failed. "At no time during immunisation could S antibodies be demonstrated in the serum of this animal, although the material injected contained in solution all the S obtainable by this method from the bacterial sediment of 7 litres of original broth culture. This is at least indirect evidence that S from non-haemolytic streptococci does not, after dissociation from the cell, lead to antibody production." Immunisation with P gave rise to antibodies which reacted only with nucleoproteins. "The six rabbits immunised with nucleoprotein received between twenty-five and thirty intravenous injections over periods of 6 to 8 weeks. No S antibodies appeared in their sera." The P antibodies produced in this way were "little, if at all, concerned in causing agglutination." They were relatively non-specific and showed group reactions with nucleoproteins of related species.

Lancefield's results bear a fairly close resemblance to what has been found on a larger scale with pneumococci and show that the antigenic analysis of *viridans* is a serious undertaking. The two most conspicuous difficulties are the diversity of the S elements and the possible confusion between "group" and "specific" reactions when using sera which contain both P and S antibodies. As her detailed analysis was confined to four strains, the question arises whether application of her methods to a much larger number would reveal some tendency to a distribution into types, just as an investigator might find his first four strains of pneumococci from pneumonia all different antigenically but, if he went on to examine forty, he would certainly be able to class many of them into groups or types.

At the present time, enough work has not been done to justify a decisive answer to this question. The indications are that the reply will probably be more or less definitely in the negative. Hitchcock¹⁷ (1924) extracted a soluble precipitating substance from non-haemolytic streptococci and used this material as antigen in precipitation and complement fixation tests. His antisera were prepared by immunising rabbits with whole cultures injected intravenously. He found that his strains were an "entirely heterogeneous group" and also remarked that "such cross-reactions as do occur within this group are not useful in the systematic classification of these organisms." His strains were 12 in number, 3 from blood cultures in rheumatic fever, 1 from a heart valve in rheumatic endocarditis, 4 from blood cultures in bacterial endocarditis, 2 from normal throats, 1 from sputum in bronchial asthma, and 1 from sputum in bronchopneumonia.

It must not be forgotten that information on this subject may also be gained from many of the bacteriologists who have attempted a serological classification of *viridans* by use of the

ordinary laboratory tests and without entering into refinements involving chemical analysis. But, on consulting the literature one meets with conflicting statements and there is only a remote prospect of ever arriving at a really useful classification. Perhaps the reason is the multiplicity of Lancefield's S substances.

A few examples will suffice. I have already mentioned Clawson's statement that, out of 10 rheumatic strains and 10 immune sera prepared therefrom, 7 were found by agglutination tests to form a homogeneous group, only 3 being "individualistic." This seems rather encouraging, but many bacteriologists have been unable to establish a clear-cut grouping and their "individualistic" strains are generally in the majority. M. H. Gordon¹⁸ (1922) reported on 17 strains of *viridans* or *salivarius*; they were from the blood or heart of 16 cases of malignant endocarditis, with one exception which came from the pericardial fluid of a case ending fatally during a first attack of rheumatic fever. "Among the sixteen streptococci there appear to be at least twelve different serological types. The streptococcus from the rheumatic case so far is serologically unique, but so also are some of the others from cases of malignant endocarditis." G. K. Stone¹⁹ (1923), writing on complement fixation in streptococcal infections, states that he examined 10 strains of non-haemolytic streptococci obtained from cases of malignant endocarditis. "In all cases the patient's serum gave a positive reaction with the homologous coccus. The end-point varied from 1 in 800 to 1 in 6400. The serum showed a high degree of specificity for the homologous coccus. No cross-fixation at all was demonstrable with some of the heterologous cocci tried; with others cross-fixation occurred, both with cocci belonging to the same group as the homologous coccus and with examples of the other groups, though this cross-fixation was to a much lower titre than the homologous fixation." W. A. Kreidler²⁰ (1926) isolated streptococci from the blood in a relatively high percentage of cases of endocarditis. They were all green except one, which was a typical haemolyser. "There occurred no cross-agglutination, cross-precipitation or cross-complement fixation among the strains isolated. From these observations and the fact that no absorption of agglutinins took place it appears impossible to group these streptococci on the basis of their serological reactions. Immune bodies for the homologous strain were found in the blood of all patients tested."

It appears, therefore, that there is a strong tendency to emphasise serological differences amongst strains of *viridans*. Those associated with acute rheumatism do not appear amenable to grouping either into a single class or into a reasonably small number of types. And one ought not to ignore the fact that occasionally the streptococcus isolated from these cases is not *viridans* but *haemolyticus*. This increases the difficulty of attempts to find a reliable "hall-mark" by which the supposed causal agent may be identified.

But the resources of immunologists have not yet been exhausted.

It is well known that the properties of diagnostic sera depend to a considerable extent on the methods of their preparation, which are not uniform in the hands of different bacteriologists. Some sera emphasise antigenic differences; others bring to light underlying resemblances. So it is possible that future work may bring some sort of order into what is now an apparent chaos in the serological attributes of the streptococci associated with acute rheumatism. The subject is certainly of sufficient importance to justify further investigation.

Koch's Postulates.

B. anthracis is invariably found in the disease which is clinically known as anthrax; it is not found in any other disease; a culture of the bacillus produces the typical disease in experimental animals; and from animals thus infected the bacillus is recoverable in pure culture. Similarly with certain other diseases Koch's postulates are fulfilled up to the hilt. Contrasted with such examples, the claims of *S. viridans* to be the cause of rheumatic fever appear distinctly feeble. But bacteriologists of the present day are not prepared to exclude a bacterium as the cause of an infection for the sole reason that Koch's postulates have not been satisfied.

Problems of aetiology are too complex to justify the idea that, sooner or later, a special germ, as distinctive as the bacillus of anthrax, will be found to explain each infectious disease. More than one kind of bacterium may produce the same clinical disease, *e.g.*, in septicaemia or in food-poisoning. And the same bacterial species may produce infections which are very different in their clinical aspects; the diseases already accepted as being due to streptococci are a good example. Moreover, the very wide and important class of bacteria which Bail has called "half-parasites" are particularly complex. Sometimes they invade the tissues and produce disease and sometimes they are only capable of a saprophytic existence; the same strain may change from the one condition into the other, but the reasons for such change are highly obscure. Superadded to this complication, *viz.*, variability of the bacterium itself in its equipment for virulence, there are the manifold factors, also very imperfectly understood, which may increase or lower the susceptibility of the human host.

These considerations do not imply any disparagement of Koch's postulates, which are still entitled to the highest respect. It may still be said that, provided there is absolute identity of conditions as regards both bacterium and animal host, they ought to be fulfilled. The point is that this proviso is frequently unattainable. In dealing with human infections of which the cause is *sub judice*, the conditions are too complex for complete analysis, even when observations on the human subject are supplemented by animal experiment and bacteriological work *in vitro*. As these conditions vary in unknown ways, a bacterium

may be the true cause of a disease though its pathogenicity is inconstant.

Recognition that a bacterium may produce disease in more ways than one makes it difficult for the bacteriologist to plan suitable "control" experiments. It certainly seems very doubtful whether cultures of *viridans* from endocarditis lenta can be regarded as appropriate "controls." As Clawson and many others have urged, rheumatic fever and bacterial endocarditis may be different stages of the same infection; or they may be different types of infection due to the same bacterium. And the experimental behaviour of a strain of *viridans* which has not been associated with either of these diseases is not particularly helpful as a "control"; whether it resembles or differs from the rheumatic strains, its behaviour will not settle the question as to the aetiology of the latter.

Main and Subsidiary Issues.

First a few words may be said about the alternative theory that streptococci are only secondary invaders, the true causal agent being a filter-passer. The two obvious difficulties about this view are that there has been no satisfactory demonstration of an ultra-microscopic virus and that diseases thought to be due to viruses of this nature are generally of high infectivity, a property which is certainly not associated with rheumatic fever. It may, however, be argued that knowledge of filter-passers is still in a rudimentary condition and the door is open for fresh discoveries. That is true enough. So anyone who wishes to pursue the search is entitled to say that this question remains a main issue in the aetiology of acute rheumatism.

To return to *viridans*. Further work on blood cultures is of primary importance. The results are never likely to be so consistently positive as, for example, the detection of meningococci in the spinal fluid from cases of cerebro-spinal fever. But positive findings are already substantial enough to justify a thorough antigenic analysis by modern methods, involving chemical work such as Lancefield's as well as resort to absorption of agglutinins and other refinements of immunological tests. As regards other tests, most recent workers have failed to correlate serological reactions with capacity to ferment particular carbohydrates. These "sugar tests," if they are not to be abandoned altogether, cannot be regarded as more than subsidiary.

Occasionally cultures of *viridans* have been obtained from rheumatic joints and, more rarely, from subcutaneous nodules. These reports are interesting, but, owing to the preponderance of negative results, I think the majority of observers agree that such data have not assumed major importance.

Throat cultures do not seem to me to be helpful. Streptococci are of such common occurrence in this situation, in other diseases and in health, that a positive result is of little or no significance. And, if the bacteriologist finds that the throat of a rheumatic fever

patient is absolutely free from streptococci, it can always be said that he might have found them at an earlier stage of the infection, or that they may have been absorbed not from the throat but from the intestine.

Under the heading of "Experimental Lesions" I have already discussed the significance of attempts to produce in the rabbit, by inoculation with cultures of streptococci, a condition bearing resemblance to human rheumatism.

There remain three questions which may be disposed of briefly, because there is no consensus of opinion as to the appropriate answers. (1) Salicylates are of therapeutic value in rheumatic fever; can it be shown that they have a specific action in rabbits experimentally infected with *viridans*? (2) The arthritis of rheumatic fever is sometimes said to be due to a condition of "hypersensitiveness" or "Allergie"; can such a condition be demonstrated experimentally by inoculating rabbits first with dead streptococci or extracts thereof (in order to sensitise them) and subsequently with the living organisms? (3) What are the effects of a vaccine prepared with the supposed causal organism? As the results of the work which has been done on these three subjects are inconclusive and more or less discordant, no useful purpose would be served by attempting to criticise them from the bacteriological standpoint. These matters mainly concern the clinical aspects of rheumatic fever and should therefore be referred to the clinician for adjudication.

Summary.

The present position is that many experienced observers think that acute rheumatism is caused by *Streptococcus viridans*. They admit that they have not proved their case completely, but they assert, with good reason, that there is no rival theory which has made substantial headway. Examination of the present position practically amounts to an analysis of the evidence for and against this organism.

From a consideration of current laboratory work on *S. viridans*, I think the following questions may be raised as being of prominent interest. What is the significance of negative results in the search for this bacterium? What help is gained by attempts to produce in rabbits lesions resembling those of acute rheumatism in man? Is identification of rheumatic strains of *S. viridans* likely to be accomplished by serological methods? How far is the fact that Koch's postulates have not been fulfilled a valid objection against the streptococcal theory? What are the main issues awaiting elucidation?

The apparent discrepancy between the success of some bacteriologists in cultivating *S. viridans* from the blood and the failure of others cannot be interpreted with dogmatic certainty. Some of the failures may be due to complete absence of the organism as an infective agent; or they may mean that it has been missed because it only gains access to the blood stream intermittently

and in small numbers and is of low viability in this environment. The latter explanation is certainly plausible.

Experiments on rabbits justify the conclusion that strains of *S. viridans* derived from cases of acute rheumatism do not produce lesions which can be distinguished from those caused by strains of non-rheumatic origin. Attempts to reproduce in rabbits the histological picture of the human disease are inconclusive and unimportant.

Attempts to identify rheumatic strains by serological tests have failed. But, before concluding that the task is hopeless, more work is needed, involving the elaborate methods of combined chemical and serological analysis which have been employed with pneumococci.

Owing to the known variability in the infective capacities of streptococci and in the kinds of disease which they may produce, the fact that Koch's postulates have not been fulfilled is not an insurmountable objection to the theory under discussion.

From the bacteriological standpoint, interest appears to be mainly focussed on further analysis of *S. viridans* by biochemical and immunological methods, though the theory of an ultra-microscopic virus cannot be absolutely excluded.

REFERENCES.

1. Supplement to Brit. Med. Journ., July 3rd, 1926, p. 13.
 2. Journ. Inf. Dis., Vol. 36, p. 444. 1925.
 3. Johns Hopkins Hosp. Bull., Vol. 36, p. 99. 1925.
 4. Deutsch. med. Wochenschr., p. 625. 1924.
 5. Journ. Exp. Med., Vol. 40, p. 525. 1924.
 6. Arch. Intern. Med., Vol. 19, p. 381. 1917.
 7. Bull. de l'Ac. Roy. de Belg., p. 76. 1914.
 8. Journ. R.A.M.C., Vol. 20, p. 1. 1913.
 9. Journ. Exp. Med., Vol. 40, p. 543. 1924.
 10. Journ. Exp. Med., Vol. 40, p. 773 and p. 789. 1924.
 11. Lancet, 1912, Vol. 2, p. 1209.
 12. Journ. Inf. Dis., Vol. 11, p. 243. 1912.
 13. Journ. Exp. Med., Vol. 19, p. 417 and p. 429. 1914.
 14. Journ. Exp. Med., Vol. 24, p. 739. 1916.
 15. Journ. Path. and Bact., Vol. 24, p. 333. 1921.
 16. Journ. Exp. Med., Vol. 42, p. 377 and p. 397. 1925.
 17. Journ. Exp. Med., Vol. 40, p. 575. 1924.
 18. Journ. State Med., Vol. 30, p. 432. 1922.
 19. Brit. Journ. Exp. Path., Vol. 4, p. 318. 1923.
 20. Journ. Inf. Dis., Vol. 39, p. 186. 1926.
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PART II.

THE ACUTE RHEUMATIC INFECTION IN CHILDREN,
CONSIDERED IN RELATION TO THE PREVENTION
OF HEART DISEASE AS A PROBLEM OF PREVENTIVE
MEDICINE.

I.

. Prevalence of Heart Disease.

Few facts in modern medical statistics are more striking than the relative and absolute increase in the number of deaths ascribed to diseases of the heart. Diseases of the heart caused 64,059 deaths in England and Wales in 1925, an increase of more than 3,000 on 1924. Of every thousand deaths which occurred in 1925, 135, or one-eighth of the whole number, were due to diseases of the heart. In other words, the tax of mortality in England and Wales in 1925 was headed by five groups of disease in the following order :—

- (1) Diseases of the heart and of the circulation, 177, of which diseases of the heart accounted for 135 in every 1,000 deaths.
- (2) Bronchitis, pneumonia and other respiratory diseases, 165.
- (3) Cancer, 110.
- (4) Diseases of the nervous system, 99.
- (5) Tuberculosis (all forms), 85.

The same upward tendency of the death rate from heart disease is visible among the industrial population of the cities of the United States and Canada since the year 1919. Figures for the several broad geographical regions of the United States and Canada show that the highest death rate for cardiac disease in 1925 was that for the middle Atlantic States—161·7 per 100,000 population, which is, however, lower than the corresponding figure for England and Wales, which is 164·7 per 100,000.

Urbanization and industrialization appear to be potent pre-disposing factors in the production of heart disease on both sides of the Atlantic,* but no discussion of death rates from heart disease can be profitable unless the age distribution of the population concerned is closely considered, owing to the concentration of mortality upon the older age groups, when the factor of true senile degeneration becomes overwhelming. The mortality at different ages from heart disease forms a regular curve almost identical for both sexes, showing very gradual increase of the remarkably low relative rates applying to all ages up to about

* Annual Report of Chief Medical Officer, Board of Education, 1914 ; Statistical Bulletin Metropolitan Life Insurance Co., Nov., 1926.

45, after which rapid increase occurs and continues at an ever-accelerating pace throughout the rest of life to extreme old age. The reader is referred to the full discussion of this subject given in the Registrar-General's Statistical Review, 1922, Text, p. 86.

Occupational influences, however, seem to have less effect than geographical and environmental influence, as is shewn in the supplement to the seventy-fifth annual report of the Registrar General, Part IV. Matthew Young* has studied the geographical distribution of heart disease in England and Wales by examination of standardised death rates at ages of 25 years and upwards. He concludes that "a definite association exists in the counties between the distribution of mortality from organic heart disease and heart diseases in the aggregate and the mortality from acute rheumatism. . . . The relative incidence of acute rheumatism appears to be the essential factor that determines the incidence of heart disease, although other factors, possibly mainly environmental, may have some influence on the rate of mortality in different periods."

Geographical and racial variations in the incidence of rheumatic heart disease in the United States have recently been studied by Wood, Jones and Kimbrough,† who find that *rheumatic* heart disease of all types is nearly twice as common in Massachusetts (39·8 per cent. of all cases of heart disease) as in Virginia (22 per cent. of all cases of heart disease), and that organic heart disease is almost twice as common in the negro as in the white, though in the negro hypertension (53·5 per cent.) and syphilis (21·4 per cent.) seem to be the chief aetiological factors producing heart disease. These racial differences had already been pointed out by Dublin‡, who said :—"Coloured males show rates from heart disease during the main period of life from 65 per cent. to 80 per cent. higher than for white males of the same ages; those for coloured women are twice as high as for white women at a number of age periods."

In Calcutta rheumatic carditis is very rare, only one doubtful case being found in 4,800 postmortems spread over 37 years—"A striking confirmation," says Rogers,§ "of the practical if not complete absence of rheumatic fever in Bengal."

II.

The Mortality from Heart Disease is increasing although Acute Rheumatism appears less virulent in type.

It is interesting to note that the mortality from heart disease is increasing despite an apparent change in the nature of the rheumatic infection. All observers are agreed that acute

* The Lancet, 19th September, 1925: Journal of Hygiene, 10th November, 1921.

† American Journal of the Medical Sciences, August, 1926.

‡ Incidence of Heart Disease in the Community, Nation's Health, 1922, p. 453.

§ Rogers. Pathological evidence bearing on Disease Incidence in Calcutta. Glasgow Med. Jl., Jan.-Feb., 1925.

rheumatism is assuming a less acute and virulent form than that which was present 40 or 50 years ago. Horder,* for example, tells us :—

There seems little doubt that cases of severe acute endocarditis during the first attack of the disease are less common than formerly. Further, and perhaps explaining the fact, rheumatic fever in the severe form which was so common even twenty-five years ago is not at all a common disease to-day. Is it not rather uncommon to see a young man, either in hospital or in private practice, presenting the picture of severe rheumatic fever? Yet such cases were an almost daily experience a generation ago. The hyperpyrexial form of the disease, and cases in which cerebral symptoms were a striking feature, seem entirely to have disappeared.

The proportion of in-patients in hospitals suffering from frank acute rheumatism, when compared with the total number of patients suffering from all medical diseases, shews a striking diminution both in England† and in America.‡ Lambert, however, has shewn that at the Bellevue Hospital this diminution is not found in the number of admissions of children under 15 years of age with acute rheumatism, which remain constant. Miller has pointed out the interesting fact that pericarditis as a complication of rheumatism is very much less frequent than it used to be, and Horder in this connection writes :—

May it not have been even then due to some change in the interaction between the virus and the tissues resulting from a change in the virulence of the infecting agent; or to some change in the resistance of the tissues infected? And may not the continued tendency, since Church's analysis was made, for pericarditis, and especially pericarditis with liquid effusion, to become less common, together with the lessened severity of the cases of acute endocarditis, and of rheumatic fever generally, be expressions of one or both of these same changes?

On the other hand, what may be termed the minor manifestations of acute rheumatism appear more frequent than formerly. This may, however, to some extent, be a matter of increased attention and keener diagnosis.

“But with this change,” says Horder, “in the character of the disease we call acute rheumatism or rheumatic fever, so that its more severe forms and the coincident forms of acute endocarditis and pericardial effusion have become much less common, there has probably occurred an increased frequency of the subacute and chronic forms of the infection, together with subacute and chronic endocarditis.

“It is constantly noted by those who see many ill children that rheumatic heart disease frequently arises in the absence of arthritic signs or, indeed, of any signs other than those indicative of the carditis. Although this fact was well known to physicians forty years ago, the number of cases of rheumatic heart disease found in children who present no other feature seems now to bear a larger percentage to the whole than formerly.”§

* Horder. Lumleian Lecture. Brit. Med. Jl., 1926, April 5th.

† Miller. Brit. Med. Jl., 1923, Oct. 23rd, p. 702.

‡ Lambert. Jl. Amer. Med. Assoc., 1920, 74. April 10.

§ Op. cit,

III.

What Proportion of Organic Heart Disease is due to Rheumatic Infection ?

One difficulty in estimating what proportion of heart deaths is due to rheumatic heart disease is the fact that the mortality statistics are tabulated according to the International List of Causes of Death. This list is based generally upon anatomical characters rather than aetiological, and thus heart diseases are classified anatomically (pericarditis, aortic valve disease, mitral valve disease, etc.) rather than aetiological (rheumatic, syphilitic, degenerative, infective, or arteriosclerotic). Another difficulty arises from the fact that most studies in this subject are founded either upon clinical observations or postmortem findings in series of cases of hospital patients.

Now, as it is acknowledged that the disease is much more prevalent in the classes from whom such patients are mainly drawn, and that it is much more often seen in hospital than in private practice, such hospital studies may to some extent increase the apparent proportion of heart mortality which is due to the acute rheumatic infection.

In England, it is generally assumed that almost all cases of deaths due to heart disease under 40 years of age may be ascribed to rheumatism, and that deaths due to syphilitic heart disease do not occur to any appreciable extent under the age of 40.* Some authorities place the proportion of deaths due to heart disease which are ultimately traceable to rheumatism as high as 50 per cent. of the total deaths from heart disease, a figure probably somewhat too high. Probably 40 per cent. is a safer figure, in which case we must ascribe some 25,000 deaths annually to heart disease of rheumatic origin in England and Wales, deaths moreover not occurring in the later age groups, but in those in which life is sweetest and most valuable.

In America one fortunate result of the intensive campaign against heart disease has been a close study of this subject embodied in several recent articles. One of the most important of these is an analysis of 1,052 cases of organic heart disease in adults (639 men, 413 women) by Wyckhoff and Lingg.† They found that in these 1,052 cases, 449 patients (230 men, 219 women) had rheumatic heart disease (which was rare after the age of 50, more than half of it occurring before 30, nearly half the patients were over 40), about two-fifths were arteriosclerotic in origin, about one-tenth syphilitic and about one-tenth of unknown origin. Two-thirds of this one-tenth of unknown origin presented lesions typical of rheumatic heart disease and occurred before the age of 50.

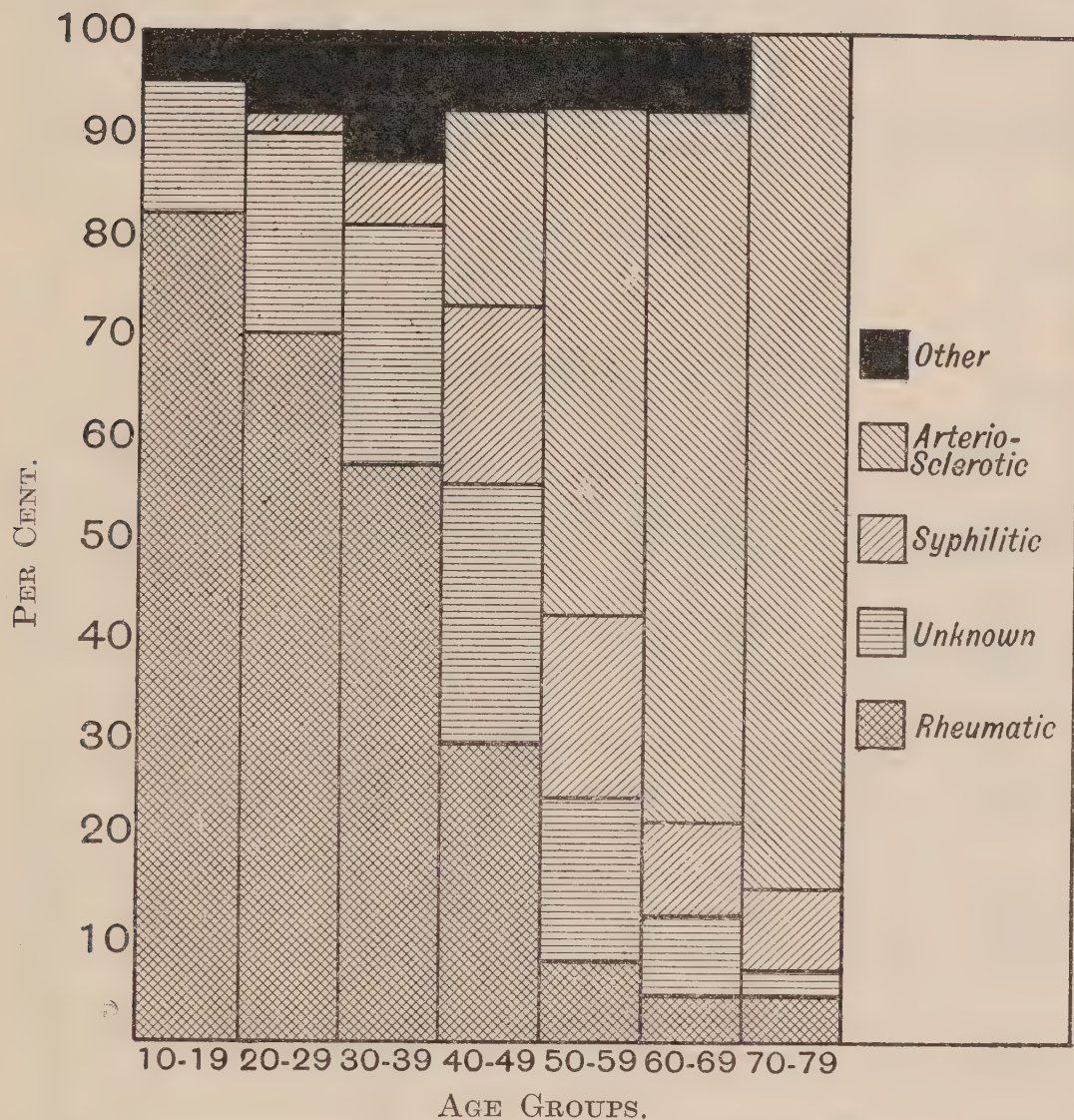
The experience of continental and other observers is quoted on the proportion of cases of organic heart disease due to acute

* Carey F. Coombs. Rheumatic Heart Disease in Bristol Lancet, 1920, ii, p. 226.

† The American Heart Journal, 1926, April.

rheumatism; thus Mengel (Leipzig, 1896) 59.2 per cent. (670 cases) ; Fatianoff (Basle, 1910) 46.7 per cent., chorea 1.8 per cent. ; Gerhardt (Wurtzburg, 1913) 64.3 per cent., chorea 1.3 per cent. (300 cases) ; Leuch (Zurich) 65 per cent. ; Schmidt (Jena) 36.5 per cent. ; Horder 48 per cent. (150 cases) ; Christiania 46.5 per cent. (242 cases) ; Litten 35 per cent. (400 cases) ; Aldmuhler, 1919, 50.4 per cent. (462 cases). An interesting diagram (I), by

DIAGRAM I.



Relative percentages of the various forms of heart disease found in Hospital In-patients at each age group. (After Wyckhoff & Lingg, Am. Heart Jl., April, 1926.)

kind permission reproduced here, shews in the various age groups the relative proportions of cases of rheumatic origin, of unknown origin, or syphilitic, arteriosclerotic and other miscellaneous origin.

Another important article already quoted is that by Wood, Jones and Kimbrough* from the medical services of the University of Virginia Hospital, Virginia, and of the Massachusetts General Hospital, Boston, based upon 300 cases of organic heart disease admitted as in-patients to the medical service of the University of Virginia Hospital and 323 cases admitted to the Massachusetts General Hospital. Each case was fully studied

* Amer. Jl. Med. Sciences, 1926, August.

and some two-thirds of the patients were electro-cardiographed. In Massachusetts 39.8 per cent. of the cases were rheumatic in origin, whilst 32.8 per cent. were arteriosclerotic and hypertensive, 12 per cent. were hypertensive, 4.3 per cent. were syphilitic and 1.5 per cent. were congenital. The percentage of all cases in each age group which were purely rheumatic in origin in their 323 white patients at their Massachusetts General Hospital is shown compared with the corresponding percentages in Wyckhoff and Lingg's series in Diagram II—the general agreement is

DIAGRAM II.

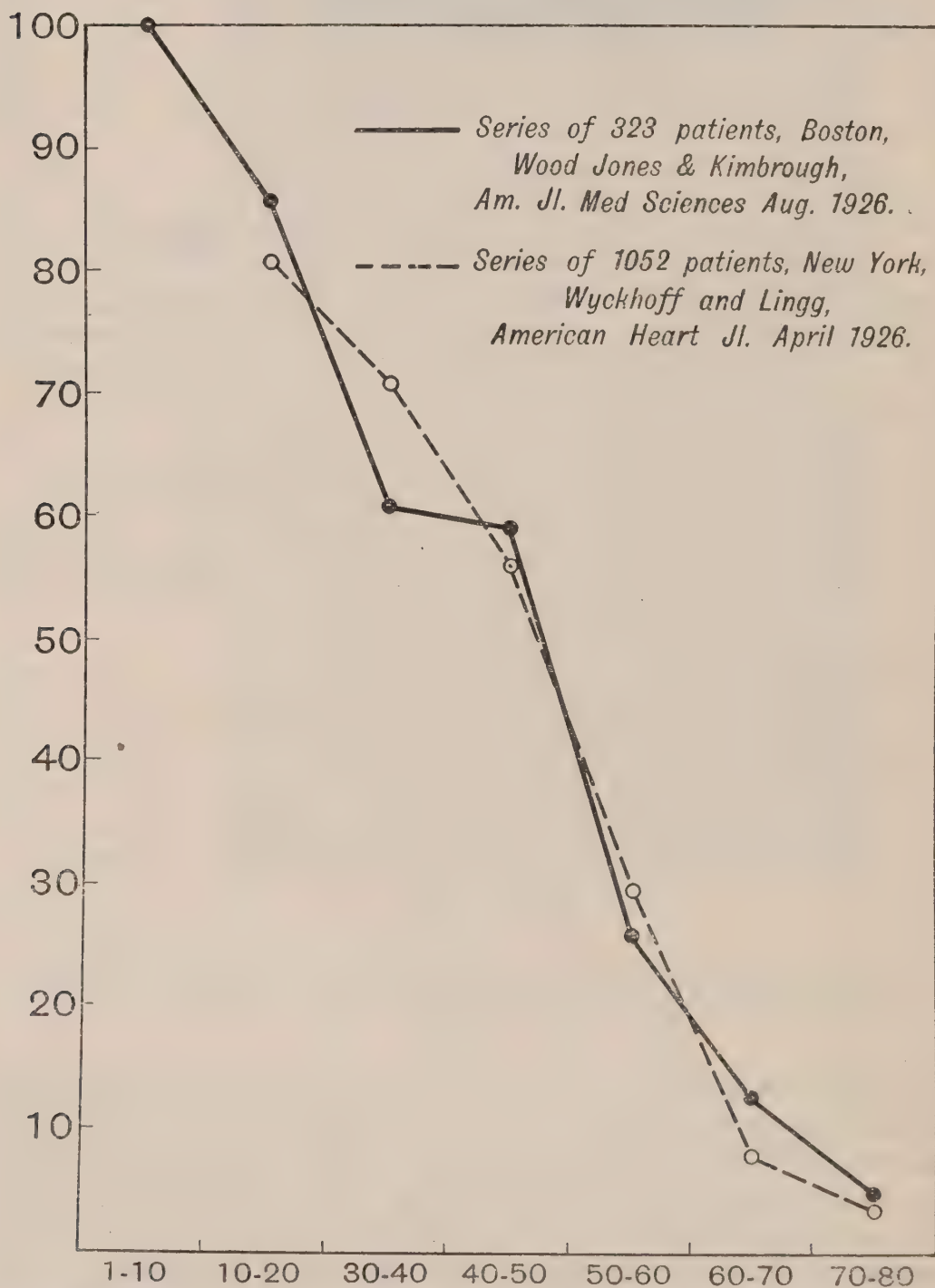


DIAGRAM SHOWING FOR EACH AGE GROUP THE PERCENTAGE OF ALL CASES OF HEART DISEASE (=100) WHICH ARE PURELY RHEUMATIC.

Hospital In-patients.

Black line, 323 cases (white patients). Massachusetts General Hospital, Wood, Jones and Kimbrough, Am. Jl. Med. Sciences, Aug. 1926.

"Broken" line, 1,052 cases (96.5 per cent. white patients). New York. Wyckhoff and Lingg.

remarkable. In the 300 cases from Virginia, owing apparently to the great incidence of hypertention and syphilis upon the negro patients, the cases of rheumatic heart disease formed only 22 per cent. of the 300 patients as against the 46 per cent. patients whose heart disease was due to hypertention.

Even in aortic regurgitation (a condition peculiarly likely to be syphilitic in origin) I. M. Harmer* found that 27·2 per cent. of the cases, all between 20 and 70 years, were undoubtedly rheumatic in origin compared with 37·2 per cent. of cases undoubtedly syphilitic positive. The length of time between the first attack of rheumatic fever and the patient coming under observation for aortic regurgitation varied from 1 to 40 years, but the average period was 11·6 years.

IV.

(1.) Predisposing Conditions.

The report of the Child Life Investigations Committee of the Medical Research Council, "Social Conditions and Acute Rheumatism,"† recently published, embodies the result of intensive investigation into many aetiological factors concerned in the causation of acute rheumatism in children. Such important factors as heredity, environment, infectivity, housing, dampness of house and site, overcrowding, the incidence of sore throat, and seasonal variations in incidence, have been investigated and are reported upon with a thoroughness which has scarcely been equalled before in the study of acute rheumatism, and which renders the discussion of these aspects of the problem unnecessary here. The reader is, therefore, advised to study the Medical Research Council's report before or concurrently with the present one.

It may, however, be convenient to state here that the results of the investigation of the occurrence of rheumatism in the families of rheumatic and control children may be said generally to confirm those found by other workers. There was a significant difference between the incidence of rheumatism among the living members of the families of rheumatic children as compared with those of the control series. It was also found that in 260 out of the 721 rheumatic families, or 36·1 per cent., there are one or more persons in addition to the rheumatic patient suffering from rheumatism.

Precise evidence of "infection" of healthy persons by a case of rheumatism has not been obtainable. Of 382 persons sleeping in the same room as 192 rheumatic children, 50, or 15·0 per cent., showed evidence of acute rheumatic infection. No comparable figures could be obtained from the control families, but the incidence of acute rheumatic infection among those in close

* I. M. Harmer, University College Hospital, "Heart," 12th March, 1926.

† Special Report Series No. 114, 1927.

contact with the patient would appear to be high, and suggests the possibility of transmission of infection, as was suggested by St. Lawrence's investigation* (*see below*).

The comparison between the social conditions under which the rheumatic and control children were living has failed to reveal any difference or any factor in the social circumstances of the rheumatic children which might be described as causative. No one factor has been demonstrated that would appear to account for the higher incidence of rheumatism in families of the hospital-class as compared with those in better circumstances, with the exception of such disadvantages as would tend to lower resistance to attack by disease. The high incidence found within the rheumatic families appears to suggest that, in addition to the possibility of a hereditary predisposition, the close contact and lack of outlet characteristic of the family life of town-dwellers of the hospital-class favours the spread of the disease, especially where resistance is lowered by unfavourable conditions of life.

Perhaps the most important of these findings, for the purposes of the present report, is the suggestion of the possibility of transmission of infection. St. Lawrence, in his study of the "Family Association of Rheumatism," published in 1922,* showed that in families having one member the subject of the disease, rheumatic infection exceeds tuberculosis in family incidence and in frequency among exposed persons. St. Lawrence found that in his 100 rheumatic families the percentage of cases found of exposed persons who might have been infected from the patient was 14·8 per cent. in rheumatic infection, whilst the corresponding figure with 100 families in the case of tuberculosis was 14·6 per cent. It will be noted that the Medical Research Council's figure of 15 per cent. in the above findings corresponds with St. Lawrence's estimate. This question has an important bearing on the desirability of residential accommodation for children with acute rheumatic infection; not only is the difficulty of nursing children at home often increased by there being several rheumatic children in the same family, but there is at least a suggestion of danger of infection by allowing a child in the acute or sub-acute stage of the disease to remain in the inevitably close contact of the poor home with other children.

(2.) The Various Manifestations of the Acute Rheumatic Infection in Children.

This difficult subject can scarcely be better prefaced than in the words of G. F. Still:† "(Acute) Rheumatism is one of the many diseases which illustrate the considerable differences which may exist between the manifestations of one and the same disease when it occurs in an adult and when it occurs in a child. The conception of rheumatism as essentially a joint disease is based on

* J1. Amer. Med. Ass. 79. p. 2051.

† Diseases of Childhood, 4th ed., 1924, p. 511.

its occurrence in adolescent and adult life ; the wider and almost certainly more accurate conception of rheumatism as a general disease, probably of infective origin, is based chiefly on its manifestations in childhood.

“ In a child the articular phenomena of rheumatism become a matter of secondary importance ; indeed, judging from clinical evidence, one would say that a child may suffer severely from rheumatism who has never had a pain in its joints in its life.

“ Some of the most severe cases of endocarditis, cases in which the rheumatic nature of the lesion has been confirmed by the presence of rheumatic nodules,* have not at any time had any joint pains whatever so far as can be ascertained.”

In the case of children, then, the classical definition of rheumatic fever as given by Osler as “ an acute infection, dependent upon an unknown infective agent, and characterized by multiple arthritis and a marked tendency to inflammation of the endocardium of the valves of the heart,” can no longer content us, for indeed the truth is that no satisfactory definition of acute rheumatism in children can yet be given.

Probably it is correct to say that acute rheumatism is a general systemic infection, comparable in many ways to the infection tubercle or of syphilis, “ A chronic slowly progressive disease characterised by intervals of calm simulating complete recovery and periods of activity which entail further damage to the organism,”† that this infection usually enters the system through infected tonsils, that up to the age of puberty the brunt of the infection usually falls upon and abides in the heart, and that just before and at puberty, especially in the female child, there is a special liability of the central nervous system to infection. After puberty the brunt of infection tends gradually to fall rather less upon the heart and rather more upon the synovial membrane of the joints, although the heart is still affected in more than half even of adult patients. So that in childhood, even though many minor manifestations are also seen in acute rheumatism in children, carditis occupies the centre of the stage and is that upon which our gaze must be fixed throughout the whole rheumatic act.

The major manifestations of the acute rheumatic infection in children in the order of their importance, then, are *carditis*, *poly-arthritis* and *chorea*, and these three are followed by a train of lesser manifestations, *nodules*, *tonsillitis*, *growing pains*, and the *skin lesions* (especially erythema multiforme and erythema nodosum, which latter is held by some to be a specific and distinct infectious disease).

The prodromal signs of the rheumatic infection in children are often pallor, loss of weight, slight daily rise of temperature, accompanied by an increased pulse rate, and fatigue out of all proportion to the task or play. To distinguish what is called the pre-rheumatic child from the equally indefinite pre-tubercular

* *i.e.*, found post-mortem in the heart muscle.

† T. T. Mackie, *Am. Jl. Med. Sci.*, 1926, Aug., p. 216.

child is difficult. Both require the most careful medical supervision, and the so-called pre-rheumatic child is too often in reality already the rheumatic child.

V.

Relative Frequency of these Manifestations.

The early recognition of the rheumatic infection, as may be inferred from what has already been said, is a matter as difficult as it is important. But upon early recognition prevention may depend and it seems proper therefore for us to discuss first the minor manifestations, as they are often the first to appear.

Minor Manifestations.

Growing Pains.

These may be mild and evanescent for a few days, or may even cause a limp or stiffness on rising. They are usually described as most noticeable in the hamstrings behind the knees, but H. P. Newsholme* found that in 50 per cent. of his cases pain was referred to the front of the thigh compared with 10 per cent. referred to the hamstring muscles. Stiff neck in a child should be regarded with suspicion.

Information as to growing pains depends for elicitation upon the accuracy and memory of the child patient and upon the method and personality of the inquirer. Avoidance of leading questions is essential and yet the information must be obtained. Thus we must expect and do indeed find the widest variations in the recorded incidence of growing pains in school children, variations which have naturally affected the estimates of the incidence of the rheumatic infection in school children. The following instance illustrates the immense difficulty of assessing their true value. Two experienced school medical officers each examined about 2,500 elementary school children in attendance at school between the ages of 5–13 years (except about 200 younger and 49 older in the case of the second observer), with special reference to rheumatic infection. The first observer worked in the Eastern part of the County of Middlesex, the second amongst children of similar social circumstances in the N.E. central part of London one or two years later. The first† reported that of the Middlesex children nearly 25 per cent. had had growing pains (in addition to 2 per cent. who had a definite history of rheumatism). The second‡ reported that of the London school children only 1·4 per cent. had growing pains. (Nevertheless this observer considered 5·2 per cent. definitely rheumatic “merely suspicious

* Thesis for M.D. Oxford quoted by Kerr. *Fundamentals of School Health*, p. 277.

† Annual Report Chief Medical Officer Board of Education, 1912, p. 100.

‡ London County Council Medical Officer's Report, 1910, p. 135.

cases being excluded"). H. P. Newsholme (quoted by Kerr) examined 969 school children specially and found 37·4 per cent. had had them. Among 1,000 New York City newsboys* it was reported that 9·7 per cent. suffered from growing pains.

So much for the incidence amongst ordinary school children. From children admitted to hospital for acute rheumatism, rheumatic carditis or chorea, a history of growing pains is elicited in much higher percentages than in the school cases, and the 78 per cent. found by Ingeman and Wilson† may be taken as a representative value.

Whilst the subjective difficulties of their assessment must be admitted, the importance of growing pains (in the absence of obvious arthritis) as a symptom can scarcely be overrated. They are frequently the earliest warning of rheumatic infection,‡ and constitute, indeed the "distance" danger signal of rheumatism which may afford weeks or even months of warning. When they are present in a child with signs suggestive of tonsillar disease, it is indeed time to act, to seek medical advice and probably to enucleate the tonsils.

Recurrent Tonsillitis.

The history of recurrent tonsillitis as evidence of rheumatic infection in children in school attendance is statistically open to the same objections as were advanced against the history of growing pains. Tonsillitis is an exceedingly common disease, and in adults is one of the greatest causes of loss of work, whether measured by industrial, naval, or military statistics. Statistics are lacking of the incidence of attacks of tonsillitis in unselected school children, though there is an extensive literature dealing with the proportion of school children having unhealthy tonsils and adenoids. Probably, taking the country as a whole, it is fair to say that of elementary school children examined at routine examination, at least 5 per cent.§ have enlarged tonsils and adenoids sufficiently severe to require treatment. Children who have once manifested the major signs of the rheumatic infection, however, show many times (ten times at least) as high a proportion as this. Ingeman and Wilson found a history of recurrent tonsillitis in 77 per cent. of their hospital cases. Bertram's hospital cases gave 28 per cent.; Halsey, in his New York cardiac clinic patients, found a history of recurrent tonsillitis in 64 per cent., compared with 18 per cent. in his control series of non-cardiac children. Langmead, in his "definitely rheumatic" children still in school attendance, found 43·6 per cent. Similar per-

* The Health of 1,000 newsboys in New York City, 1926. N.Y. Tuberculosis and Health Association.

† J. Am. Med. Ass., 1924, 82, p. 759.

‡ For their importance as an early manifestation see Section VII, p. 62.

§ 5·3 per cent. routine examinations, 4·7 per cent. special examinations, Report of the Chief Medical Officer Board of Education, 1925, p. 9.

centages of diseased tonsils are found in young adult patients.* R. Miller, whose admirable summary of this matter deserves careful study,† found a history of “sore throats” in 33 per cent., and diseased tonsils in 83 per cent. In addition to recurrent attacks of tonsillitis serving as “minor manifestations” or “warning signals” of rheumatic infection, a sharp attack of tonsillitis is, in about 10 per cent. of cases of acute rheumatism, a prodromal symptom (Bertram‡ 5 per cent. Poynton§ 12·8 per cent., Wyckhoff¶ 12·7 per cent.). Not uncommonly carditis may follow directly upon an attack of tonsillitis without any arthritis or chorea. Still|| sums up the matter thus: “Tonsillitis so frequently occurs just before the onset of rheumatic pains in children that it is difficult to escape the conclusion that it bears some direct relation, possibly as medium of infection, to rheumatism.”

This question and the value of tonsillectomy are further discussed on page

Nodules.

We come to the third of our minor manifestations. Here is a tangible manifestation so important from its being the homologue of the submiliary nodule of Aschoff in rheumatic carditis, and so diagnostic that many authorities (e.g., Carey Coombs and the Medical Research Council Committee) class it as a major manifestation. In it surely we may hope we have a reliable index of the rheumatic infection. Yet as a statistical guide to the incidence of the rheumatic infection in children, the presence of nodules seems as disappointing as growing pains or tonsillitis.

The varying percentages given by reliable observers are most puzzling. Taking only child in-patients with severe and undoubted infections, Poynton (London) found nodules in 19 per cent. in one series** of cases, 28 per cent. in another††; Bertram‡ (Glasgow) in 7 per cent. of child in-patients, Ingerman§§ and Wilson 11 per cent. in 185 cases under observation for an average period of three years, whilst Vincent Coates and Thomas have found them in 80 per cent. of children considered rheumatic on other criteria. The two latter observers also consider them as a definite objective physical sign, which can be elicited in a large number of children who present themselves as out-patients suffering from subjective symptoms suggesting rheumatic infection *prior* to clinically demonstrable cardiac lesions. Cheadle, Barlow, and Warner

* Ministry of Health Report 23, “The Incidence of Rheumatic Diseases, 1924, p. 60.

† Part III of the British Medical Association’s Report of Special Sub-Committee on Rheumatic Disease in Children.

‡ Brit. Med. JI. 1925, March 14.

§ Lancet, 1920, II, p. 1086.

¶ American Heart Journal, 1926, April.

|| Common Disorders of Childhood, G. F. Still, 1924, p. 519.

** Proceedings Royal Soc. Medicine, Oct., 1921.

†† Lancet, 1920, II, p. 1026.

§§ Journal Amer. Med. Ass., March 8, 1924.

considered this manifestation as ominous of severe concurrent and progressive carditis.

Poynton states that nodules may occur in cases which follow a benign course and even in patients free from heart disease, but that this does not in any way affect the general truth that their appearance is a grave sign. He gives the following incidence in one of his series of 172 cases in children under 12, all in-patients seen within 12 months, 33 patients (19 per cent.) showed nodules, and of these 33 cases 12 were fatal, 15 gave rise to severe crippling heart disease, 4 gave rise to carditis, which later became compensated, and in two cases carditis did not develop.

Subcutaneous nodules appear to be less common in America although Brennemann* considers that they are as common in Chicago as in England. Even in England there are variations which can scarcely be explained by the individual views of observers. They appear to be more frequent in Bath and Bristol than in London, whilst in Birmingham they are rare.

Although their adequate discussion is beyond the scope of this report, which is not concerned with clinical matters, the other minor manifestations of the acute rheumatic infection must be briefly reviewed, as, like growing pains, they may often afford us that period of warning (of six weeks or six months) in which our therapeutic measures (e.g., tonsillectomy) may be taken with the fairest hopes of success. Such minor manifestations or premonitory symptoms include epistaxis, erythema multiforme, persistent headache unexplained by eyestrain, and a category of nervous symptoms which may be signs of "latent" chorea.† The latter include nightmare, talking or doing sums during sleep, habit spasms, acquired enuresis, "exaggerated fidgetiness," clumsiness, and deterioration of the handwriting. The fact that these may each or all be indications of acute rheumatic infection increases the difficulties, already seen in connection with growing pains, recurrent tonsillitis and nodules, which lie in the path of the investigator who would estimate the number of "potential cardiacs" in a child population. Some American authorities would place the proportion of "potential cardiacs" high—as high indeed as 14 per cent.‡ a figure which has recently been suggested by K. Simpson§ at Barking in Essex and by Vercoe at Chelmsford.¶

VI.

Major Manifestations.

Rheumatic Fever.—Arthritis, though not in the child the predominant sign of acute rheumatic infection which it is in the adult, nevertheless occurs in some 60 to 70 per cent. of all children

* Amer. Jl. Diseases Children, 1919, XVIII, p. 179.

† R. Miller, Lancet, 1909, Dec. 18.

‡ Health of 1,000 newsboys.

§ Brit. Med. Jl., Jan. 1st, 1927.

¶ Annual Report of the Medical Officer for Chelmsford Borough, 1925.

with rheumatic infection sufficiently ill for admission to hospital. Acute rheumatic arthritis is rare under four years of age, extremely rare under two years; attacks in such children are usually grave and the prognosis is bad.

The case mortality of acute rheumatic infection in hospital patients is much higher also for children than for adults. Thus of Poynton's 172 cases in children under 12, 18 per cent. of the boys and 10 per cent. of the girls died, a case mortality of 13 per cent. for both sexes, whereas the average case mortality for adults in hospital is usually considered to be about 2 per cent. (Osler; Dinnerstein J. Am. A. 78, 346).

The annual attack-rate (for children under 15) of rheumatic fever when it was compulsorily notifiable in Norway was about 0.8 per 1,000 (average of four years). Prinzing, in the City of Ulm, gave the following annual attack rates per 1,000 (average of eight years) for both sexes: 0-5 years, 0.45 per 1,000; 5-10 years, 0.61 per 1,000; and 10-20 years, 1.93 per 1,000. The last-named attack-rate accords closely with the attack-rate (both sexes combined 16-24 years) of 2 per 1,000 found in the Ministry of Health inquiry investigating rheumatism in insured adults of both sexes. The attack-rates for rheumatic fever for certain naval schools recently published* are, however, considerably higher. Greenwich R.N. School is the only one of these institutions where the ages of the boys ($11\frac{1}{2}$ to $15\frac{1}{2}$ years, 90 per cent. resident, 10 per cent. day boys) bring it within the scope of this Report. Here the attack-rate is 6 per 1,000 per annum (nearly three times that of the Navy† as a whole in 1921). It is probable that this high rate is largely due to the care in recording those cases which, being mild in character, might have escaped record or been recorded as "subacute" elsewhere. But after making all allowances, there must be still a relatively high attack-rate, especially when contrasted with the incidence found in the Poor Law Schools used as a control in the Medical Research Council's inquiry into "Social Conditions and Acute Rheumatism." Here the incidence was exceptionally low. It is possible that the large numbers of boys in the large dormitories at Greenwich may account in some measure for the apparent increase of infectivity, and the riparian site‡ may also not be without influence.

For the incidence of *chorea* and of *rheumatic carditis* in children, no such attack-rates as have been given for rheumatic fever arthritis (defective as these are) exist.

We shall gain but a misleading impression from mortality

* Dudley, "Droplet Infection in Semi-isolated communities," M.R.C. Special Report No. 111. 1926.

† Shaw. Proc. Roy. Soc. Med., Dec. 8th, 1924.

‡ But as to riparian site the case of Eton College may be compared—one case of *chorea* and none of rheumatic fever in nineteen years (up to 1923) actually occurring at school. In the medical histories given on entry of 1,600 boys (usually at 13-14) there was mention of rheumatic symptoms in only sixteen. Attlee, Brit. Med. J., 1923, Oct. 20. See also page 68.

returns unless we remember that, although the immediate mortality is small, the ultimate mortality may be deferred ten, twenty or thirty years. In the main, therefore, we have to rely upon estimates of incidence in three classes of children.

I. School children actually in attendance at elementary schools and examined either at routine or special examinations.

II. Invalid or semi-invalid children

(a) at special schools for physically defective children ;

(b) absent from school for long periods, or

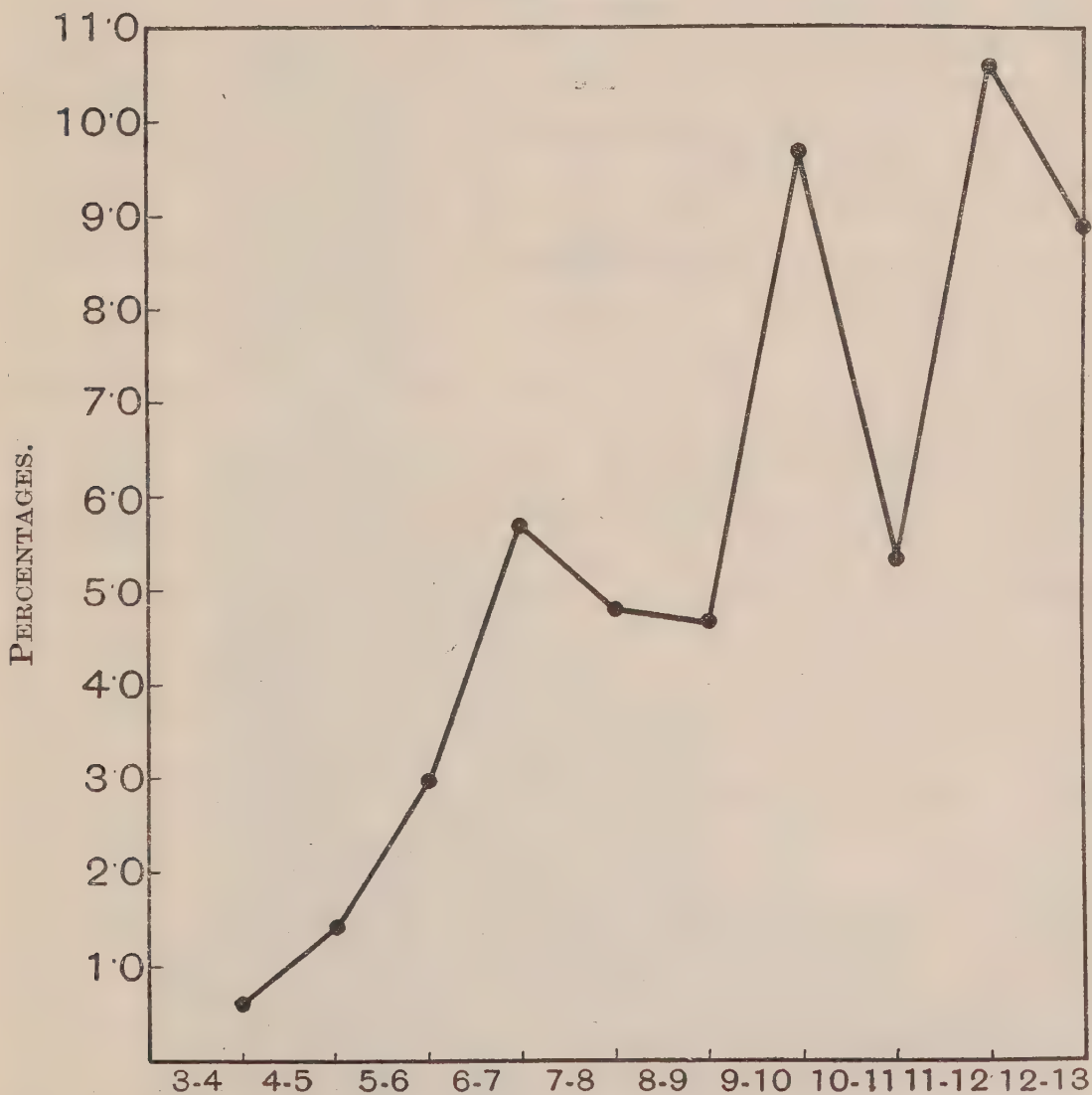
(c) referred to the Invalid Children's Aid Association.

Many of these invalid children will be recorded both in (a) or (b) and in (c).

III. Acutely ill children admitted to (a) general, (b) children's, (c) poor law hospitals.

In the first class, children in attendance at school, we naturally find but few cases of *arthritis* ; the condition is obvious and respected, and the child affected kept in bed or taken to hospital.

DIAGRAM III.



AGE INCIDENCE OF ALL RHEUMATIC INFECTIONS IN SCHOOL CHILDREN.

Chart showing percentages of London school children found to be definitely rheumatic at medical examination in school. (After Langmead, L.C.C. M.O.'s Report, 1910, p. 135.)

Chorea.—Though there are but few official figures, we have certain observations which reach a fair measure of agreement. Langmead (L.C.C. Report, 1910) in 2,556 children found 0·7 per cent. with evidence of chorea. Hadfield (L.C.C. Report, 1911), in 2,942 boys found 0·3 per cent., in 3,050 girls nearly 1·0 per cent. Of 1,000 newsboys in New York City actually working, 1·7 per cent. had chorea.

The greater incidence of chorea upon girls than upon boys is well known. Chaikin (L.C.C., 1922, p. 65) found 75 girls in 124 cases, the excess being chiefly in the older girls. In the 12–13 years age group it may be as much as 3 to 1, a ratio suggested by Gowers. Osler, on the other hand, gave the ratio as 2 to 1, a proportion confirmed by Wall,* who found in his series of 278 cases of first attacks of chorea, that at every year of life there were almost exactly twice the number of girls as boys. The maximum age incidence of chorea is probably a little later (one or two years) than that of arthritis, reaching its apex about 11–12 years.

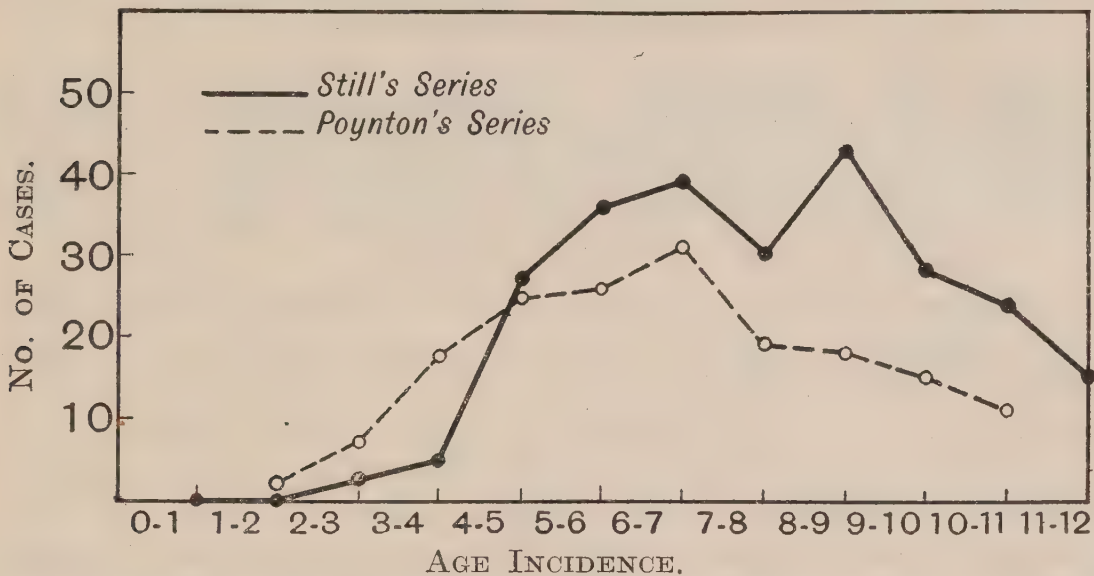
Hospital statistics have long shown that the incidence of all the rheumatic manifestations rises rapidly from a comparatively low level at 5 years to a maximum about 10 years of age. It is therefore only natural to expect that the proportion of children found suffering from all rheumatic manifestations will be higher among the intermediate age children (8–9) than amongst entrants (5 year-olds) and still higher among the 12–13 year group than among the 8–9 year group. As chorea has a somewhat later maximum incidence it will show this point clearly. So great, however, is the rise in incidence that some have ventured to say that not only is acute rheumatism a “school-age” disease, but that it is often a “school produced” disease. Especially is this remarked of chorea.† The close moist atmosphere of unventilated classrooms, the frequent lack of facilities for drying damp clothes and wet boots, the stress of competition in large classes in elementary schools, and school anxiety in the more conscientious girl just at the period of her most active growth, may be factors predisposing to an attack of chorea. Exaggerated fidgetiness, lack of concentration, and deterioration in writing may be early symptoms of chorea, and it is important that teachers should be alert to recognise that sometimes treatment and not reproof is required for such children as exhibit these symptoms. Wall* considers that it is inexpedient for a choreic child to attend school, though that it is difficult to furnish evidence that schooling is responsible for making a healthy child choreic. It is significant that acute rheumatism and chorea are not prevalent in private preparatory schools or the Public Schools. Possibly home circumstances and domestic nurture may be playing a larger part than has hitherto been assumed.

* Bradshaw Lecture, *Lancet*, 1920, ii, p. 1081.

† 88 per cent. of first attacks between 5–15 years (Wall), 278 cases. 82 per cent. of first and subsequent attacks between 5–15 years, London Hospital, 726 cases, Wall, *Lancet*, 1920, Nov. 27, 1083.

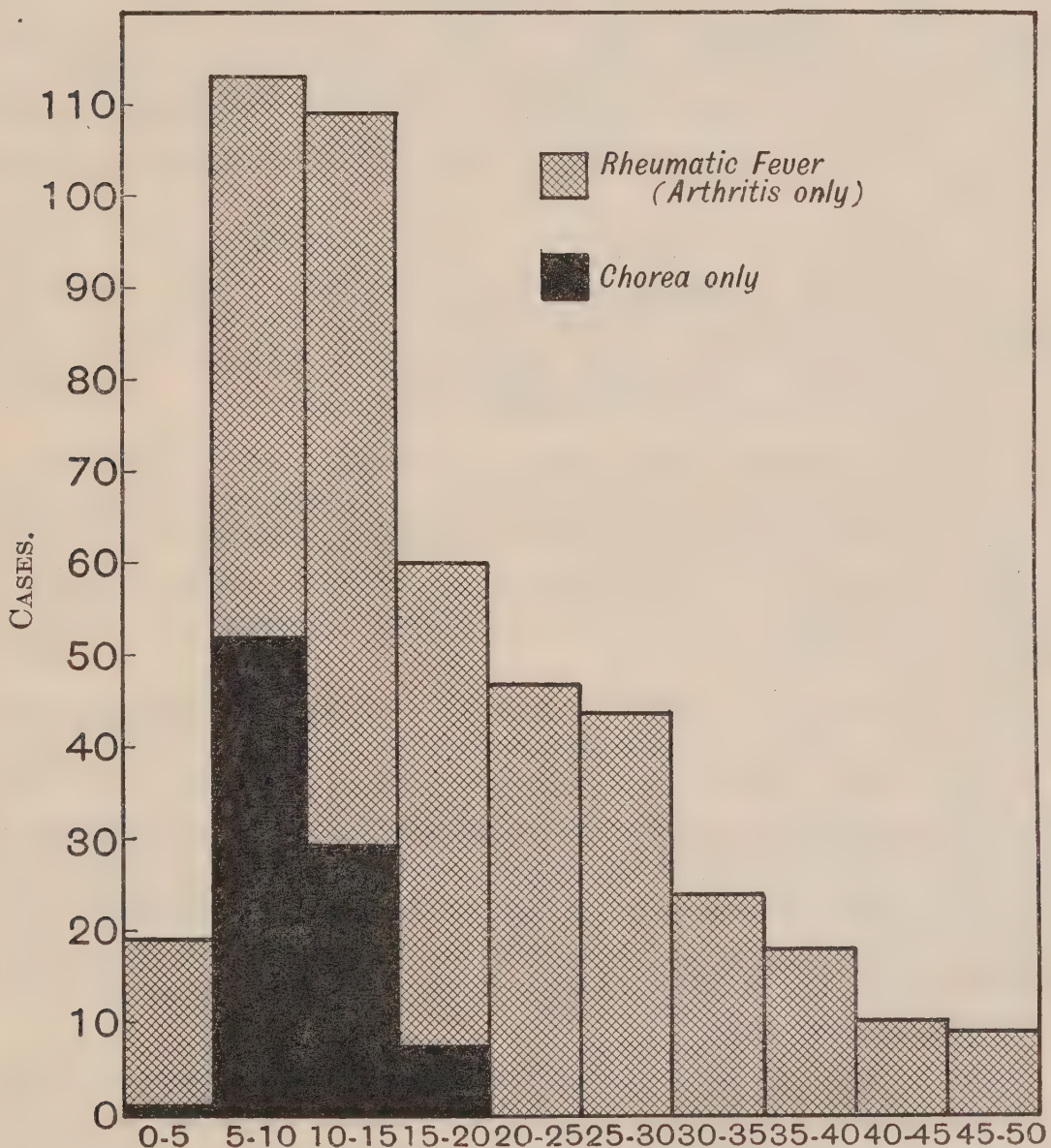
DIAGRAM IV.

Age Incidence of Acute Rheumatism as shewn by the ages of admission to a Children's Hospital (age limit 12 years), Great Ormond Street.



Black line.—Ages from a series of 251 cases admitted in 1897-8, by kind permission of Dr. Still. (See "Diseases of Childhood," p. 514.)
 "Broken" line.—Ages from a series of 172 cases admitted in 1919, by kind permission of Dr. Poynton. (See Lancet, 1920, Nov. 27.)

DIAGRAM V.



RHEUMATISM.—Age incidence of first attacks in a General Hospital (Presbyterian Hospital, New York, after Thomas T. Mackie). In-patients of all ages up to 50. (Amer. Jl. Med. Sci., Aug., 1926, p. 202.)

Incidence of heart defects in ordinary School Children seen in routine examinations.

There are approximately 5,000,000 children in average attendance in Public Elementary Schools in England and Wales. Somewhat more than one-third of these were subjected to routine medical examination in 1925, the actual total being 1,798,397; and a further 820,953 were also inspected as "special cases" (*i.e.*, selected by teachers, etc., as specially needing examination). These totals do not include medical re-examinations of children found to be in need of medical attention at previous examinations. Information as to the incidence of organic heart disease in all these children is not available, but in 1924 an analysis was made of the defects revealed in a large sample, 598,167, made up of the elementary school children of the three age groups (5-6, 8-9, and 12-13 years), examined in London and in 24 large districts representative of the whole of England and Wales during the course of *routine* examinations.

Of these 598,167 children, 4,285 (or 0·7 per cent.) were considered to have organic heart disease; 3,231 (or 0·5 per cent.) of these being referred for observation only, whilst 1,054 (or 0·2 per cent.) required treatment. In addition 1·1 per cent. of the whole number examined were considered to have functional heart disease, which in 0·1 per cent. was severe enough to require treatment.

This incidence of 0·7 per cent. organic heart disease in *routine* examinations of elementary school children of all three age groups in England and Wales (1924) may be compared with Scotland (1924) 0·52 per cent.; New York* (250,000 elementary school children, routine examination) 1 per cent.

We may therefore take it that an incidence of 0·5 per cent. of heart defect for which only supervision is required and 0·2 per cent. of heart defect sufficiently severe to require treatment are conservative figures for the incidence of organic heart disease in children actually in attendance at ordinary elementary schools in England and Wales.

J. M. Martin† has recently pointed out in a preliminary note that in Gloucestershire there seems to have been a heavy incidence of organic heart disease in elementary school children born round about the year 1913, and that this liability has steadily diminished among the children born subsequently. The general average of the percentages found is, however, much higher than that found by most other observers, and deductions therefrom must on this account await the results of the further investigation promised in the preliminary note.

Some school medical officers differentiate in their returns between organic and functional defects, others hold that a definite

* R. H. Halsey, *Jl. American Med. Assoc.*, 1923, April 7, p. 971.

† *Brit. Med. Jl.*, February 19th, 1927, p. 349.

diagnosis is no easy matter in the circumstances under which school examinations had been held, and, moreover, that the distinctions between the two conditions are becoming less differentiated by the advance of knowledge. The following table shows some figures of incidence of organic and functional defects together by sex and age group found at *routine* examination in children actually in attendance at public elementary schools:—

PERCENTAGES.

—		5 years	8-9 years	12-13 years	All ages
		Per cent.	Per cent.	Per cent.	Per cent.
London C.C., 1925 (197,702 children)	Boys	not stated	2.8	2.6	2.71 both sexes.
	Girls	not stated	2.9	3.8	
Glasgow,* 1924-25 (? about 57,000 children)	Boys	1.6	1.7	1.9	1.7
	Girls	1.2	1.9	1.8	1.6
Bath,† 1924 (8,653 children)	Both	2.25	2.28	4.15	2.87
	Sexes				

The Glasgow figures analysed into congenital organic, acquired organic and functional disease are as follows:—

PERCENTAGES IN ORDINARY SCHOOLS, 1924-5. GLASGOW.‡

—			Organic			Functional
			Congenital	Acquired	Total Organic	
5 years	Boys	..	0.3	0.5	0.8	0.8
	Girls	..	0.2	0.4	0.6	0.6
9 years	Boys	..	0.3	0.5	0.8	0.9
	Girls	..	0.2	0.7	0.9	1.0
13 years	Boys	..	0.1	0.7	0.8	1.1
	Girls	..	0.2	0.5	0.7	1.1
All ages	Boys	..	0.2	0.6	0.8	0.9
	Girls	..	0.2	0.5	0.7	0.9

The proportion of congenital cases to acquired is high compared with London, where about 14 per cent. of the total organic is usually considered to be congenital,§ or with Bristol, 13 per cent.¶ At Bristol also in a series|| of 202 cases of organic heart disease

* E. T. Roberts, Public Health, April, 1926, p. 215.

† R. E. Thomas, Bath City Annual Report, 1924.

‡ E. T. Roberts, "Public Health," April, 1926, p. 215.

§ Branson, London County Council Medical Officer's Report, 1910, p. 159.

¶ Annual Report, School Medical Officer, Bristol, 1925, p. 36.

|| Communicated by Dr. Adkins.

diagnosed at school medical examinations and re-examined by cardiologists 22, or 11 per cent., were congenital.

It is indeed remarkable that the incidence of a disease, which appears to be so largely influenced by environment, should be so much lower in Glasgow than in London, and also that in Glasgow the incidence upon girls is no greater than upon boys. It is suggested in the London report that the greater incidence upon girls may be explained by their greater confinement to the house and to their household duties as they approach the school-leaving age. Whether these factors are less potent in Glasgow is doubtful. Even in Glasgow, however, the percentage of organic heart disease doubles during the compulsory school period (Bruce).* Nairn Dobbie†, however, examining 10,000 London children at routine examinations found the following percentages: 0.1 per cent. both sexes under 5; 0.25 both sexes at 7; and 0.7 per cent. at 12 years of *acquired* heart defect. These percentages compare favourably with Glasgow.

Class II. Rheumatic children in special crippled schools or absent from school.

The special section on the manifestations of Rheumatism in the Report of the School Medical Officer for the London County Council, 1925, p. 124, gives much information on this class of rheumatic child. "There are about 1,000 of these children attending special (physically defective) schools whose hearts have been seriously and permanently injured;‡ and there are from 600 to 700 children absent from school for long periods on account of rheumatism. These last represent 25 per cent. of the chronic invalidity amongst children, and include all, or almost all, the children for whom special arrangements are still necessary.

"A census is taken each year, in November, of the number of children reported chronically out of school (*i.e.*, for three months or more in the year), and the numbers of these for the past four years are set out in the following table, in which those absent on account of rheumatism are also shewn separately:—

	1922	1923	1924	1925
Total chronically absent	2,902	2,726	2,686	2,485
Rheumatic cases	682	652	672	614
Percentages due to rheumatism ..	23.5	23.52	25.02	24.71

* Brit. Med. Jl., Oct. 20, 1923, p. 706.

† London County Council Medical Officer's Annual Report, 1924, p. 77.

‡ The numbers of cardiac children on the rolls of the London Special (Physically Defective) Schools at the end of 1925 were made up as follows:—

<i>Morbid Conditions</i>			Boys	Girls	Total
Congenital malformation .. ..	..	..	99	112	211
Acquired valvular disease .. ..	..	..	330	555	885
Acquired non-valvular disease ..	..	..	18	21	39
Recurrent or recent rheumatism ..	..	..	18	22	40
Recurrent or still present chorea ..	..	..	18	32	50
Total .. ..	..	..	483	742	1,225

In about 11 per cent. of the cases acquired heart disease the condition followed a history of chorea.

“The 614 rheumatic children absent in November, 1925, are classified as follows :—

	Boys	Girls	Total
Rheumatism	51	93	144
Heart disease	86	138	224
Chorea	75	171	246

“The *annual* number of children (newly) admitted for heart disease to the Council’s special schools is at present between 250 and 300.”

In November, 1926, a rheumatism register was commenced by the London County Council’s school medical service ; in the first two months 1,024 cases were reported, many in the hope that institutional treatment would be provided for the patients.

The following are the numbers of new cases taken under the care of the Committees of the Invalid Children’s Aid Association* in the following years :—

	1923	1924	1925
Rheumatism	360	364	458
Chorea	402	567	641
Heart disease	455	601	642

These figures include cases from Greater London (e.g., East Ham, Walthamstow, etc.) as well as cases from the County of London. The large toll of chorea will be noticed, 40 per cent. of the L.C.C. children and 37 per cent. of the Invalid Children’s Aid Association’s cases in 1925. In Glasgow there were 137 cases of heart disease in the special (physically defective) schools in 1925.

Class III. Children with acute rheumatism admitted as patients to hospital.

Dr. Pugh’s report to the Metropolitan Asylums Board (Annual Report, 1925, p. 341) is full of information on this subject. With regard to London Dr. Pugh states :—

“(1) Children’s hospitals.—There are six London children’s hospitals, and I have summarised the statistics for 1924 of the five which publish annual medical reports. The total accommodation was 706 beds ; these received 10,096 in-patients, of whom 377 (or 3·7 per cent.) suffered from rheumatism or its effects (rheumatism, 99 ; morbus cordis, 117 ; chorea, 161). The pressure on the accommodation of voluntary hospitals calls for a somewhat rapid passage of patients and the average stay, omitting cases of adenoids, varied from 20 to 30 days. The stay of rheumatic cases is generally longer ; at the Hospital for Sick Children, Great Ormond Street, it averaged 60 days in 1919–20. Some children’s hospitals have their own convalescent homes and are able to transfer a small number of their rheumatic cases to them ; a few cases are transferred to special country homes of limited accommodation ; sometimes it is necessary to send these patients home to await vacancies. Physicians have long lamented the necessity for the premature return of rheumatic cases to their homes.”

General Hospitals.

For the purpose of his report, Dr. Pugh obtained the following figures for admissions for acute rheumatism and chorea during

* From the Annual Reports of the Invalid Children’s Aid Association.

1924, for some of the great voluntary hospitals ; in a few instances the cases of heart disease are also stated.

Certain Voluntary General Hospitals. London.
ADMISSIONS—IN-PATIENTS, 1924.

Hospital	Ages	Acute Rheumatism	Chorea	Heart Disease
†St. Bartholomew's ..	All ages	43	21	383
Guy's .. ..	.. ..	21	8	Not given
University College ..	.. ..	9	24	.. ..
St. George's .. ..	.. ..	28	28	.. ..
Middlesex Hospital ..	Under 16	14	14	.. ..
St. Mary's .. ..	.. 16	25	24	.. ..
Miller Hospital .. ..	.. 16	5	16	10
London Hospital .. ..	.. 7	13	9	18
Charing Cross Hospital ..	Children	2	4	2
Totals	All ages	160*	151	—

Though the above large hospitals represent under one-half of the bed accommodation of the voluntary general hospitals of London, it will be seen that there are a considerable number of rheumatic children admitted. In the case of the four hospitals which give combined figures for “all ages” it is probably safe, from calculations made from the admissions to certain Poor Law hospitals, to estimate that half their “all ages” admissions for acute rheumatism (101) were of patients under 16, and that all the chorea cases were under 16 ; so that we may say that probably the number of acute rheumatism patients under 16 was about $\frac{101}{2} + 59 = 109$, and the number of chorea patients under 16, 151. This represents less than half the voluntary general hospitals in London, so that the total will probably be about 220 and 350 under 16 respectively.

Poor Law Hospitals of London.

The following table, constructed from information kindly furnished by the medical superintendents, shows the admissions of children under 15 years for acute rheumatism, chorea, and

* Children stated as such	59
Add $\frac{1}{2}$ (i.e., 50) of the 101 patients of all ages at the four first-named hospitals	
Estimated total children with acute rheumatism	109
† In 1914 the admissions for acute rheumatism to St. Bartholomew's were said to be over 100. Miller, Brit. Med. Jl., October 20th, 1923.	

rheumatic carditis into all the London Poor Law Infirmaries in the year 1926 :—

NUMBER OF CASES OF CHILDREN UNDER THE AGE OF 15 YEARS SUFFERING FROM ACUTE RHEUMATISM, CHOREA AND RHEUMATIC CARDITIS TREATED AS IN-PATIENTS IN LONDON POOR LAW INFIRMARIES IN THE YEAR 1926.

Figures taken from returns furnished by the medical superintendents of the Infirmaries named.

Infirmary	Acute Rheumatism		Chorea		Rheumatic Carditis	
	Boys	Girls	Boys	Girls	Boys	Girls
Bermondsey.. ..	18	20	13	11	10	12
Bethnal Green	10	16	6	6	14	10
Camberwell	11	19	5	13	17	7
Chelsea	3	3	1	2	0	1
Fulham	9	5	8	6	3	4
Greenwich	5	4	5	8	1	1
Hackney	4	5	2	17	3	6
Hammersmith	4	4	1	3	0	4
Hampstead	2	1	1	1	1	0
Holborn	1	3	8	6	2	1
Islington	6	9	5	6	2	5
Kensington	4	2	6	5	0	0
Lambeth	7	10	4	3	14	6
Lewisham	2	1	2	7	1	3
London (City of)	1	0	0	1	1	0
Marylebone	10	5	2	4	1	1
Paddington	3	3	0	3	1	2
St. Pancras (South)	2	1	0	0	1	0
St. Pancras (North)	6	4	2	7	0	1
Poplar	98	80	18	13	3	4
Shoreditch	4	2	2	8	2	3
Southwark	8	12	11	16	23	7
Stepney :—						
St. Peter's	2	4	3	3	6	5
Mile End	8	7	7	12	2	3
St. George's-in-East	12	9	10	10	6	4
Wandsworth	14	9	5	14	5	7
Westminster	2	2	0	2	0	0
Woolwich	1	4	4	2	0	2
Total, London	257	234	131	189	119	99

A total of :—Acute rheumatism .. 491 cases of both sexes.

Chorea 320 „ „

Rheumatic carditis .. 218 „ „

• Total 1,029 children under 15.

Considerable additions would have to be made to include Greater London—thus the corresponding figures for 1926 for West Ham are :—51 acute rheumatism, both sexes under 15, 41 chorea, and 30 rheumatic carditis; for Croydon :—3 acute rheumatism, 4 chorea, and 5 rheumatic carditis.

We may, therefore, estimate the total admission of children as in-patients to the London Hospitals yearly to be approximately as follows :—

Estimated number of children admitted as in-patients :—

To Children's Hospitals..	439	(377 + one Children's Hospital figures not given, say $\frac{1}{6}$ th of 377 — 62).
To General Hospitals ..	570	
To Poor Law Infirmaries	1,029	
Estimated total ..	2,038	

There are, in addition, the children* received into the country hospitals of the Metropolitan Asylums Board, but most of these have been transferred from the Poor Law Infirmaries, so they have been excluded from the above estimate to avoid counting any child twice. A few of the children in the infirmaries have been transferred there from general hospitals, but this is exceptional.

The children who are admitted as in-patients to these institutions are at any rate appropriately treated during the acute stages of their diseases, although it is open to question whether the busy ward of a city hospital is the appropriate place to treat a child with acute rheumatism or chorea.

Most of the children, however, who attend the hospitals are not ill enough, or not fortunate enough, to secure admission as in-patients—they must perforce attend as out-patients. It is this class of out-patient child which gives rise to the main part of the practical problem before us ; in them, perhaps, is produced the main bulk of *preventible* rheumatic heart disease.

Dr. Pugh's report includes a letter from the Almoner of Guy's Hospital from which the following may be quoted :—

"I think it may interest you to know that 52 children have, to my knowledge, been sent to infirmaries during the past three months from the out-patients' department here, suffering from rheumatism or chorea in an acute stage ; and 16 have been referred to the Invalid Children's Aid Association for institutional treatment. These figures do not represent the total number of acute cases, and the number of children with sub-acute rheumatism attending as out-patients at intervals would be difficult to ascertain. It must, however, be very large, and, on the principle that prevention is better than cure, it would appear that these early cases should be given as much consideration as the acute cases. The children who are seriously ill are usually referred to me by the physicians with a request to provide immediate nursing treatment under skilled medical supervision, followed by prolonged convalescent treatment under supervision to ensure the best results. Few of these children can be admitted to such a hospital as this owing to the pressure on beds here, which precludes the possibility of blocking many with these very prolonged cases.

* "The number of rheumatic children received at the Board's country hospitals from the guardians' hospitals and discharged in 1924 was 228 (carditis, 120 ; chorea, 90 ; debility after rheumatism, 18) : the average stay in the country hospital was 136 days for cases of carditis, and 90 days for cases of chorea. Children treated at the guardians' hospitals thus have the advantage that their stay can be longer and they have the opportunity of transfer to one of the Board's country hospitals or seaside homes." (Pugh.)

Immediate admission to the infirmary for treatment during the acute stage, with a view to transfer when fit to a M.A.B. hospital, such as Queen Mary's or The Downs, has seemed to us to be the best solution of the problem at present ; but, unfortunately, experience shows that the children do not always go to a M.A.B. institution, and we have record of cases in which children have returned to this hospital, for perhaps the third time within a few months, with symptoms of acute rheumatism, having been nursed for short periods in the infirmary and then discharged to their homes. The few that are admitted to the wards here also present a problem as, being the more severe cases, transfer to a suitable institution is especially desirable as soon as the acute symptoms have subsided. Unfortunately the voluntary societies have neither the accommodation nor the funds for many such long and difficult cases."

The elucidation of this aspect of the problem appeared so desirable for the purpose of this Report that it was determined to explore it thoroughly in one great London hospital. The recent inquiry by the Child Life Investigations Committee of the Medical Research Council into the relation of social conditions and acute rheumatism was directed strictly to the purposes of aetiology, and its valuable report deals only with these. But during the preparation of the latter much valuable material bearing upon the present question was also collected. The Medical Research Council, therefore, at the request of the Chief Medical Officer of the Ministry of Health, asked Mrs. Forest Smith, who had correlated the Council's previous findings, and who had investigated the social conditions of the patients at St. Thomas's Hospital, to re-examine the case notes of the St. Thomas's series of cases for the special purposes of this Report, and to ascertain the numbers and other facts concerning all rheumatic children seen in the Children's Department during 1926. The information thus obtained has been placed at the disposal of the Ministry by the Medical Research Council for inclusion in the present Report. It has seemed convenient to present Mrs. Forest Smith's report as a separate section, and it is to be remembered when reading it that it gives a particularly favourable instance for consideration, great attention having been given at St. Thomas's Hospital to this question, and that in few hospital out-patient departments have admissions to wards, infirmaries, convalescent and special homes for these little patients been more earnestly sought after. It should also be remembered that the age limit was under 12.

It may be convenient at this point briefly to summarise some of Mrs. Forest Smith's main conclusions. She records 508 children under 12 attending during the year 1926 in this single department of one single hospital ; 22 per cent. of these already had cardiac damage and an additional 21 per cent. had symptoms of threatened cardiac involvement ; 34 acute cases were admitted to the wards of St. Thomas's and 14 to infirmaries or other hospitals ; 68 with more chronic conditions were sent (often after considerable delay owing to long waiting lists) to special institutions or convalescent homes, but 392, or 77 per cent., many of whom would have been recommended for admission had there been any accommodation available, were treated at home—in

homes, that is, where the conditions rendered it absolutely impossible to provide the necessary rest and quiet and to keep the child in bed. Actual instances are described.

Mrs. Forest Smith's second series of 473 children who had been under observation for a minimum period of two years and an average period of 3·2 years, showed a higher percentage of those with cardiac lesions (30 per cent.) and practically the same percentage of those with a cardiac condition suggestive of organic damage (23 per cent.). This percentage of cardiac damage is significantly higher than that found in the 1926 series, which contained a higher proportion of earlier cases. In the longer period series 15 per cent. had no relapses, 37 per cent. had one relapse and 48 per cent. had two or more relapses. Another interesting point is the frequency of familial infection.

VII.

Rheumatic Infection in Children Treated as Out-Patients— M. Forest Smith.

CONTENTS.

- I.—Method of investigation.
- II.—The incidence of rheumatic disease in the Children's Out-Patient Department, St. Thomas's Hospital, during the year 1926.
- III.—The incidence of cardiac involvement in cases of rheumatism.
- IV.—The difficulties met with in treating rheumatic children as Out-Patients living in their own homes.
- V.—An account of the resources utilised to obtain treatment away from home in cases where this was essential.
- VI.—The number of cases of rheumatism in children of 12 years or under from 400 families under observation from 1923-4 onwards :
 - 1. The incidence of cardiac damage among these children.
 - 2. The number of relapses sustained.
- VII.—Summary and Conclusion.

I. METHOD OF INVESTIGATION.

The objects of this investigation were first to ascertain the number of children brought to St. Thomas's Hospital during a single year suffering from rheumatism. It was found that time did not permit of the investigation of records other than those in the Children's Out-Patient Department. This department deals only with children of twelve years or under, older children being seen in other parts of the hospital. It has not been possible to enumerate the children over twelve years of age who applied for treatment for rheumatism, so that it must be understood that the figures given in this Report do not give a complete account of the demand on the hospital for treatment of juvenile cases of rheumatism and only concern children of up to twelve years of age. Thus are lost three years of heavy incidence, the years 12 to 15.

The total number of children under 12 treated for rheumatism was found by examination of the medical notes of all children seen in the Children's Out-Patient Department during the year 1926. It is to be understood that where the term rheumatism is used in this section, acute rheumatism or rheumatic fever, chorea and rheumatic carditis only are meant.

Secondly, the incidence of cardiac damage among these rheumatic children was investigated. Only those with undoubted lesions of rheumatic origin were classified as damaged. If there was any doubt, the case was otherwise classified.

Thirdly, some account is given of the difficulties met with in treating cases of rheumatism in their own homes and of the means available for dealing with these children. The data for this section of the Report was obtained by kind permission of the Lady Almoner, Miss Cummins, without whose complete records it would have been impossible to trace out the social history of each child.

Lastly, a series of cases drawn from 400 families investigated under the auspices of the Child Life Committee of the Medical Research Council from 1923-4 onwards were further investigated, and their medical notes examined to discover the incidence of cardiac damage and the frequency of relapses since the onset of the disease.

II. THE INCIDENCE OF RHEUMATIC DISEASE IN THE CHILDREN'S OUT-PATIENT DEPARTMENT, ST. THOMAS'S HOSPITAL, DURING THE YEAR 1926.

In this department alone 489 children under twelve years were brought to the hospital suffering from rheumatic manifestations. In addition to these, 19 children under twelve years were admitted to the wards direct from the Casualty Department owing to the urgency of the case. There were, therefore, 508 children of twelve years of age and under requiring treatment for rheumatism and its effects, of whom 231, or 45·5 per cent., were boys, and 277, or 54·5, per cent. were girls.

These cases have been grouped under three headings according to the main type of manifestation for which they were under treatment, and the numbers and sex incidence in each group are shown in Table 1.

TABLE 1.

Showing the outstanding manifestation of rheumatic disease and the condition of the heart in children under twelve years of age who attended the Children's Out-Patient Department or were admitted (15 cases) direct to the wards during the year 1926 at St. Thomas's Hospital.

Under treatment for	Condition of the Heart	Number of Cases		
		Male	Female	Both Sexes
Rheumatism ..	With definite lesion	13	17	30
	With suspicious signs	30	33	63
	Normal	52	62	114
	Total	95	112	207
Chorea	With definite lesion	12	15	27
	With suspicious signs	16	29	45
	Normal	78	97	175
	Total	106	141	247
Rheumatic endo-carditis	.. .. .	30	24	54
	Total numbers	231	277	508

III. THE INCIDENCE OF CARDIAC INVOLVEMENT IN CASES OF RHEUMATISM.

From Table 1 it appears that among these children 55 boys, or 23·8 per cent., and 56 girls, or 20·2 per cent., in all 111, or 21·9 per cent., had hearts definitely damaged by the disease. There were, in addition, 46 boys, or 19·9 per cent., 62 girls, or 22·0 per cent., in all 108, or 21·3 per cent., whose hearts have been classified as suspicious, that is, they have a cardiac condition which is suggestive of organic damage, though such a diagnosis cannot be made with certainty. This group comprises cases of dilatation of the heart, cases with localised systolic murmurs at the apex, which are conducted to a certain extent towards the axilla, but which on further examination appear to show signs of restoration of function.

Thus one child in five had definite damage to the heart and a further child in every five showed symptoms of threatened damage. In this series there were 289, or 56·8 per cent., in which the heart was normal at the time of this investigation. There is a strong probability that if these children were examined again at some future date the percentage of normal hearts would be reduced, as it was found that in the series of children, described later in the

Report, who have been longer under supervision, the percentage of normal or undamaged hearts was 46·9—a reduction of some 10 per cent. as compared with the 1926 series, which contained a higher proportion of early cases.

IV. THE DIFFICULTIES MET WITH IN TREATING RHEUMATIC CHILDREN AS OUT-PATIENTS LIVING IN THEIR OWN HOMES.

It is obvious from the above figures that each of these rheumatic cases presents a demand for prolonged observation and treatment. In treating a case of rheumatism as an out-patient living at home the physician is at a great disadvantage. Nearly every one of these children at some stage of his attendance is ordered complete rest in bed for periods varying from a few days to several weeks. This treatment, so vitally important to the child's recovery, is in his own home extremely difficult to carry out. Even if the mother can be brought to realise the necessity of complete rest, which is not always easy to accomplish, and if the child proves amenable to home discipline, which, especially in the case of the nervous child or one suffering from chorea, is rarely the case, there are many factors in the home life of the children which make rest in bed hard to secure. The mother is generally single-handed in the house, the father being out all day, and if there be older children they are at work. If the patient is the eldest girl of a young family she often spends her time nursing the baby. The mother cannot go out to do her shopping leaving the child alone with the little ones, nor can she usually take the whole family out with her. Even when the other children can be disposed of there is the problem of leaving a sick child alone in the home. There is then no one to open the door to stray callers, of whom there are many during the day, and the sick child has to get out of bed to open the door. This fact is borne out by the personal experience of the writer when visiting the homes of rheumatic children in connection with a recent investigation. Sometimes, of course, it is possible to obtain the help of neighbours in looking after a child temporarily, but in many cases there seem to be undesirable people in the house of whom the child may be afraid, which is an added complication. It is rare for a child to have a room to himself, and if this should be the case, it is difficult to make him stay there. Most of the homes face on to crowded and noisy streets or courts, and the frequent disturbances outside tempt the child to get out of bed and run to the window to see what is happening outside. In many cases where a special effort has been made to provide a separate bed for the patient this bed must almost of necessity be in the living room. When the family are at home the patient's bed is the centre of interest, the resting place for the baby, the cat or the dog, and the playground of the other children, and rest or even a moderate degree of quietness is quite out of the question. The patient is constantly excited and disturbed, and is often kept awake late at night. After the prescribed period of such "rest in bed" the child has to get up

and go out (sometimes in bad weather) to return to hospital to see the doctor, often with such a lack of improvement that he has to return to bed for a further period.

At St. Thomas's Hospital special attention is given to these cases by the Lady Almoner; each one of them is visited and the home conditions discovered and such steps taken as are possible to ensure the likelihood of the child being kept in bed, but even the most careful supervision cannot prevail against the many difficulties that are met with.

Cases.

1. A., born 1919.—First attended in March, 1924, with chorea. The mother suffered from epilepsy and was quite unable to control the child; the home conditions were wretched. There was another child of eighteen months. When visited the mother was doing her best to keep the child in bed, but he was inclined to get up if left alone. He was having insufficient nourishment, so a grant was obtained from an Army Charity for eggs and milk for him. The father was constantly out of work. In June, 1924, the child was no better, and was recommended by the doctor for admission to an institution. Arrangements were made for him to go, but at the last moment the father refused his consent to vaccination—a condition rigidly enforced by the Home. No persuasion would move the father, who produced an exemption certificate. As the family were then under the Guardians, the father was prevailed upon to apply to them for admission of the boy to the Infirmary. He was sent by the Guardians to a suitable institution on the first vacancy, on 9th September, 1924—three months after the original recommendation was made. He returned after two months' stay, but by the time he was brought back to hospital there was some recurrence of chorea. During December the mother went into a hospital for her confinement, and the child was looked after by neighbours and friends. In January, 1925, the visitor reported:—"The home is a wretched one and the mother no idea of how to manage the child; she scolds and threatens him the whole time." The strain on the nerves of the parents is illustrated by the fact that the father, when bringing him to a children's party, said to the workers: "If he don't sit still you should hit him—that makes him better." It was felt the child would be better at school, and he continued to attend the hospital for medicine and supervision until January, 1927. During this period the home was constantly visited and conditions improved as far as possible. Though pale, miserable and thin, the child had no serious relapse until January, 1927, when he was sent home to bed for a fortnight. When visited the door was opened by the patient, with bare feet and scanty clothing. The mother was looking miserably ill, and declared she could not keep him in bed as he was in such an excited state. He had to share a bed with his younger brother. On his next attendance at the hospital he was again recommended for admission to an institution, and arrangements are now under consideration.

2. B., born 1913.—This boy belonged to a family well known to the hospital on account of the ill-health of various members. An elder boy had been under treatment since 1917 for aortic regurgitation. Another was attending in the Orthopædic Department, and both B. and his brother C. were under the Children's Department for rheumatism. The mother had myocarditis and was in a very bad state of health generally. The father was attending in the Tuberculosis Department. The mother had to attend the hospital almost daily with one or other of the family. In November, 1923, C. had an attack of acute rheumatism and was sent home to bed for ten days. There were seven children in the home, which was small, dark, stuffy, and dirty, with very insufficient sleeping accommodation for the numbers. When visited the boy was not in bed nor had he

been kept in bed at all. This was not surprising in view of the number of children, and the fact that so many of them were attending hospital. The mother could not be convinced of the necessity of carrying out the instructions given, and if she had been, it would have been impossible to secure even a moderate amount of rest or quiet for the child in his own home.

3. D., born 1912.—This boy was the third child of a family of five known to the hospital since 1917. Two girls had been under treatment for severe eye trouble. Owing to the neglect and indifference of the mother to instructions, the case required frequent visiting and firm handling until 1921, when the sight of the girls was saved from permanent damage.

D. had not been to the hospital till he appeared in March, 1924, with acute rheumatism and was sent home to bed, and the mother told to report again in ten days. The family lived in an old house in bad repair, overcrowded with furniture and rubbish—the remains of a small shop which the parents had given up owing to lack of trade—and always dirty and untidy. When visited a few days after his attendance, the boy was found out in the street roller skating, from which nothing would deter him. The mother stated that she was quite unable to control the boy, and could not keep him in the house, much less in bed. From past knowledge of the woman's character, it was evident that no amount of visiting and supervision would avail to improve matters, and that nothing but removal of the boy from his home could ensure adequate management during an acute attack.

4. E., born in 1917, female.—This child was brought to the hospital with chorea, with a history of having been 15 days in bed. No previous history of rheumatism. She was ordered complete rest in bed at home. The home consisted of three rooms, and the family of the parents and five children, the eldest 13 years of age. The home was visited and the report came back: "We visited this child to-day and were sorry (but from past experiences not much surprised) to find that she was not in bed. Her mother said she could not keep her there. She was sitting up over the fire in the kitchen. Our visitor saw the bedroom, a stuffy, dark room, the windows were shut. The real difficulty about keeping the child in bed seems to be that the father is on night duty, and has to sleep during the day. The patient sleeps in the double bed with her mother at night, and the father in the same bed by day. As there is no other bed in the room, it is difficult to see where the child can be put to bed in the daytime. Even if there were another bed in the room, it could not be expected that the child would stay there quiet all day while her father is sleeping. There are two boys, who have another room to themselves, and a baby, who I suppose sleeps also with the patient and her mother in the double bed. There is a sofa in the boys' room, and the visitor suggested that this might be brought into the kitchen and used in the daytime for the child, but, of course, the whole family would be in and out of the room all day long, so that it would be anything but ideal. The mother said she would consider this arrangement. She seemed limp and not very capable of dealing with the situation, and remarked that the child would not sit still but was always jumping up and following her about."

The sleeping arrangements were re-arranged, but the difficulty of improving them was increased by the fact that the child suffered from nocturnal enuresis. On her next attendance she was ordered a further fortnight in bed. The visitor found the conditions still most unfavourable, and the child up and about each time she called. If, on her next attendance, the child is considered in need of further rest in bed, it would appear the only possible plan to advise her being taken to the Infirmary. Owing to the enuresis no Home would admit her.

A further point is that it is by no means uncommon for two or even three children under twelve years of age from one family

to be under treatment for rheumatism at the same time. The tendency of the disease to attack more than one member of the family has been noted in a Report by the Medical Research Council on the Social Conditions of Rheumatic Families, and in 400 families investigated in connection with this Report it was found that in one instance four children under 12 in one family were attending the hospital for rheumatism at the same time, three children in six instances, and two children in 57 instances, and although in this 1926 series precise figures have not been prepared, this feature was noticeable in going over the notes.

The burden for the mother of securing proper rest and supervision for these children is indeed a heavy one. Especially does this burden seem to rest on the mother of children with chorea. These children are generally irritable, quarrelsome, and extremely difficult to control. They are afraid to be left alone for even the shortest time and the slightest opposition to their wishes results in scenes and tears, and they get "on the nerves" of the entire family. Such conditions tell against their recovery and in time reduce the mother to such a state of despair that she will do anything for peace, and her attempts to secure an adequate amount of rest and quiet are abandoned.

5. F., born 1918.—This child originally attended in September, 1925, for tonsillitis and was recommended for operation at a later date. At the end of the month she was found to have chorea, and was sent home to bed. The home conditions were reported on as follows:—"The home consists of two rooms. There are four children, and F. usually sleeps in the same bed with two other sisters. There is a sofa on which it might have been possible to arrange for her to sleep, but unfortunately one of her sisters has broken her arm recently and has to sleep on the sofa, so that there is not the smallest possibility of F. having a bed to herself. In addition to this, the mother and child are both thoroughly on edge and irritable, and the mother is now, of course, extra worried at having to nurse the child with the broken arm, and, I should fear, is not at all in a condition to undertake the nursing of F. The child is very fidgety and irritable, perpetually quarrelling with her younger brothers and sisters, until the mother hardly knows how to bear it. The mother said it was absolutely impossible to keep the child in bed. At the time the visitor called, she was sitting up near the window, wrapped in an old coat of her father's. Her bed is in a very dark corner of the room, and would certainly be a most depressing place to keep her in as she would not be able to see to read or do anything. The mother said she had to give in and humour the child in all sorts of ways in order to keep the peace. If she makes a tapioca pudding for her she cries for a rice one, and the mother goes away and makes one! She was making a rice pudding when visitor was there, and hoped that F. would not cry for tapioca! The crying need of the family appears to be separation of the mother and child for a time."

On next attendance the child was found to be worse and the following report was received:—"There does not seem to be the faintest hope of the child's ever getting any better in her present surroundings, indeed, she is likely to get steadily worse. She was actually in bed, but she will not be left in a room alone, so her bed is in the kitchen, where the family life goes on its noisy way, a barking dog being one of the party. The other children came home from school and at once threw themselves on F.'s bed, asking to see the book the visitor had brought. A violent struggle over the book ensued, and the mother looked on helplessly and said: 'You see that is what always happens.' The mother herself is very

'nervy' and our visitor thinks that mother and child continually upset each other. It really seems as if In-Patient treatment were the only thing likely to effect any improvement."

This was reported to the physician in October, and he asked that she might be sent to an institution or home. She was admitted to a suitable home at the end of November, and was away two months. In January, 1926, she was not so well, and the mother asked for her to be sent away again. Her case was not considered sufficiently urgent on medical grounds for a recommendation for admission to an institution, and she was recommended for admission to a special school. This she failed to obtain, but was invalided from ordinary school for six weeks. The mother complained bitterly of the difficulty of managing the child at home. She was very troublesome and deserved punishment, but they were afraid to punish her, as it upset her so dreadfully. She would only go to bed with all the lights on, and did not sleep till 4 o'clock in the morning and kept the whole family awake.

6. G. and H., born 1912 and 1914.—These two girls were brought to the hospital both suffering from chorea. The father had been in and out of work for some years. The home was a poor one, consisting of two rooms. The parents and two boys slept in one bed, and the two girls in another room shared a small bed between them. In March, 1923, one of the girls, H., was seen, and sent home to bed for two weeks. The difficulty of keeping her in bed, and looking after the other girl, who was not at school, as well as the other two younger children, was still further increased by the fact that the mother was attending the hospital for thrombosis and herself required rest. The child could not be induced to stay in bed; she got up and went out when the mother left the house to take the others out or when she was up at the hospital attending for herself or the other children, the two younger ones being also under the doctor for other troubles. The two children with chorea seemed completely on the parents' nerves, the mother stating that their fidgiting was almost unbearable and that their father got impatient and "ollered at them," which made them worse. In May, 1923, the visitor reported: "Very unsatisfactory surroundings. The bed is very dirty, and there are no sheets or pillow-case. I should think the only chance for her would be for her to go into hospital." This was reported to the physician when she was next seen on 30th May, 1923, and he recommended that the child be admitted to an institution. No vacancy occurred until 6th July, when she was sent to a special institution. The father was then working and agreed to pay a small sum, which he could well afford, towards the cost. The child was four and a-half weeks in the institution, but the father never paid a penny. She was discharged from the institution, and, after a short time at home, went into the infirmary. The other girl, whose case was milder, still attended the hospital as an out-patient. Both children continued to attend until June, 1925, H. being little better and having frequent relapses. The home conditions were slightly better, and they were kept under constant supervision, extra nourishment, etc., being arranged for when needed. In November, 1925, H. had a further relapse, with signs in the heart, and was again recommended for admission to an institution. She was sent to the infirmary, and returned home after some weeks improved. She is still attending, but the elder girl, whose case was the less severe, is now over age for the department, and is at work, though she is still delicate, and in need of constant watching. The strain on the mother throughout the last three years of managing these two girls has been very heavy, and the irritation and worry of the home conditions have reacted unfavourably on the children.

7. I., born 1916, and J., born 1915.—Both children attended with chorea in April, 1922. I. had suspicious heart signs and both were sent home to bed. Their home was of high standard, and the maternal care excellent, but there were only two rooms. The girls slept in one bed in a small back room. It was suggested that one bed should be put

in the parent's room, but the mother stated that neither child would sleep alone. The only improvement possible was to separate them during the day. On 3rd May they were seen again, and I. recommended for an institution. She obtained an unexpected vacancy at a moment's notice on 15th May, and returned on 30th August. When seen at hospital she had still slight chorea. She continued much the same, the mother doing her utmost to manage the two girls at home until I. had a relapse in February, 1923. When seen at hospital in April, 1923, her heart was dilated, with an apical systolic murmur. She was sent home to bed. In June she was recommended for a convalescent home, and was sent away soon after for four weeks. She returned on 31st July, still with some chorea. She remained fairly well till October, when she had a relapse, and was recommended for admission to an institution in June, 1924. She went on 19th June, and was away six months, returning in November, 1924. She was not seen again at the hospital till February, 1925, when her chorea was severe. In March, 1925, she was again sent away for five months, and returned this time with no signs of chorea. Her sister, whose case was much milder, meanwhile attended the hospital as an out-patient. I. had a sudden relapse in December, 1925, and was again recommended for an institution, where she went at the end of the month. After a prolonged stay, she was recommended for some weeks in a convalescent home, and is still away.

It is hardly necessary to point out the strain on the mother entailed by these two cases. The milder case always under her care, and needing all her attention, the more severe one constantly relapsing in spite of all efforts to ensure her complete recovery, the general upset to the child at home of the constant absences of her sister, and the discouraging results of all her sacrifices constituted a heavy burden.

V. THE RESOURCES UTILISED TO OBTAIN TREATMENT AWAY FROM HOME IN CASES WHERE THIS WAS ESSENTIAL.

The homes of these rheumatic children are, in most cases, under the supervision of visitors of the Invalid Children's Aid Association, whose help has been enlisted by the Lady Almoner, and when the conditions are found particularly unfavourable this is reported to the physician who is treating the case. The Lady Almoner succeeded in making suitable arrangements for every child (82 in all) (provided the parents gave their consent), who was recommended by the physician for admission to a home or other institution, but, owing to the lack of provision for such cases, only those of greatest urgency from the medical or social point of view are recommended. If there were more accommodation, it is certain that such recommendations would be made in a much greater number of cases.

During the year 1926, 97 cases of special urgency were admitted to institutions as follows :—

	Boys	Girls	Total
To St. Thomas's Hospital from the Casualty Department	8	11	19
To St. Thomas's Hospital, from the Out- Patient Department	10	5	15
To the Infirmary or other hospitals ..	3	11	14
To special institutions or convalescent homes	31	37	68
	—	—	—
	52	64	116

Some of these children were sent away more than once, and whilst the length of their stay varied from three weeks, many of the children were sent away for prolonged periods ; some for a year or more, which seems to be the only satisfactory way of effecting real improvement in their condition. Short visits to Homes or rest in the country for two or three weeks, though possibly of temporary benefit, and in some cases suitable, do not produce any permanent benefit, the condition remaining as before or relapsing very shortly after the child's return. At present there is the very greatest difficulty in making arrangements for cases requiring long treatment. It sometimes happens that a child who is in urgent need of admission to one of the few Homes that will take such cases has to be sent away temporarily either to the infirmary or to a short-period convalescent home, until a vacancy can be obtained for it in an institution where it can be kept for a long period, or until such time as the disease appears quiescent.

8. K., born 1913.—This child first came to the hospital in April, 1923, with a history of an attack of rheumatic fever, treated at home, during which she had been three weeks in bed. In December, 1923, she was admitted to the wards for rheumatism and severe mitral disease. On her discharge at the end of January it was necessary for her to stay in bed for at least half the day, or to have a considerable amount of rest if allowed to be up. The home conditions were difficult as the mother was a widow with three children to keep. The father had died at 30 years of age from the effects of rheumatic fever. She supplemented help from the Guardians by working alternate weeks at her trade, and while she was working there was no one to look after K. Admission to a special school was arranged for K., where she was given special consideration and extra rest. She ceased to attend the hospital as the mother was unable to bring her. Reports received were fairly satisfactory until she developed influenza and was admitted to the infirmary in 1925. In January, 1926, she developed chorea, and it was suggested that she should again be admitted to the infirmary. This suggestion was not carried out by the mother as the child refused to go. Meanwhile the mother sent her back to the special school because, when she was at work, the child would not stay in bed, and quarrelled with her big brothers, who teased her. Rather than leave the child at home all day, the mother persuaded the school authorities to allow her to attend. Although she had the most careful attention at school, the authorities there felt the child ought to be in a Home, and the matter was reported to the physician in charge, who recommended her for a prolonged stay in a suitable institution. The case was not then sufficiently urgent for admission to the infirmary, and her name was placed on the waiting list for a special Home. She was admitted in April, after three months' waiting for this vacancy—the only one available. She returned after two months' stay much improved in general health with no evidence of active rheumatism then. The heart lesion was, however, severe and not improving, and the child had still to be treated as an invalid. Attendance at school was not advised, and the problem of home care arose once more. Several plans for dealing with this child were explored, but no arrangement could be made for her until, in September, 1926, she became so much worse that she was admitted to the ward. She is now attending as an out-patient, and her return to the special school has been sanctioned. Owing to the special care given her at this school, it was felt that she was better there than alone at home, but it is not an ideal arrangement for a child in her condition.

9. L., born 1913.—This girl was brought to hospital suffering from rheumatic carditis. The father was a street-seller with a precarious income, and at this time the family had no home of their own, the father

and the boys living with his brother, the mother and the girls with her sister. Home conditions being impossible for the child, she was recommended for admission to an institution in order that she might have a prolonged period of rest. At this time there was a long waiting list for every Home likely to take her case, her name was placed on the list of one of them where it stood twenty-second in order. The parents had by this time succeeded in getting rooms of their own, but as the conditions still precluded proper rest, the child was sent to the infirmary pending her admission to the Home. After some weeks in the infirmary she was able to return home, and to go to a special school, until she at last was admitted to the special Home, for which she had been waiting *five months*. Every effort was made to find an earlier vacancy, but there was none. In this family it is interesting to note that two boys, who had been seen in 1924, and were then found free from rheumatism, were observed among the 1926 cases, attending as cases of rheumatic carditis.

10. M., born 1913.—This girl was brought to the hospital in 1922 suffering from chorea. She was then recommended for admission to an institution for prolonged rest. A vacancy was found for her on 8th May. She returned after 22 weeks improved, and she attended as an out-patient from October till November, 1922, when she had a relapse, and was ordered to bed for a week. She was found up and about when visited, and was getting no rest or quiet. When seen by the doctor in January, 1923, it was found necessary to recommend her for a further stay in an institution. She was given a vacancy which another child was unable to take, and could have gone without much delay, but she became worse in the short period of waiting, and was then too ill for that particular Home. All sorts of possibilities were explored, but no suitable vacancy could be found until 17th February. She remained away a year at a special hospital, and was then sent for five weeks to a convalescent home. On her return, the general condition was very good, but she still had some chorea. As she lacked occupation she was allowed to go to school on trial. She continued attending from August, 1924, to June, 1925, without serious relapse. She reappeared at hospital in November, 1925, worse again, and was sent home to bed for three weeks. In December, 1925, there were heart signs, and further rest in bed was necessary. When visited she was found not to be in bed, but sitting up in a small and overcrowded kitchen. Her bed was in the kitchen, and, as there were six children in the family, rest and quiet were unobtainable. The physician recommended her admission to an institution on 30th December, 1925. As it seemed the only possibility, the mother, after much persuasion, agreed to apply for admission to the infirmary for the child. The Guardians arranged to admit her to a special institution direct, and for her to wait at home until an "urgent" vacancy could be obtained. She was admitted on 2nd February and was away four months. She returned but slightly improved, and was again recommended for a stay of 3-4 months in a special institution, in June, 1926. Her case was not considered sufficiently urgent for re-admission to the institution she had been in before, and as she then seemed slightly better, she remained at home until 8th September, when she became markedly worse, and an admission order to the infirmary was given. She was put on the waiting list for one of the Guardians' special Homes, and remained at home until the first vacancy occurred on 4th October, 1926; she was then admitted, and is still away.

It is obvious that such expedients cannot be employed in more than the most urgent cases.

That so many admissions into special institutions or suitable convalescent homes as have been shewn above (nearly 14 per cent. of all cases) have been obtained is due to the special attention given to the subject by the Lady Almoner and to the very complete organisation and co-operation with outside agencies—notably

the Invalid Children's Aid Association. It cannot be said that such facilities are available to the same extent to rheumatic children in the general population.

From the account given of the difficulties met with in home nursing, where it is necessary for a child to be kept in bed for any length of time, admission to an institution is essential. Yet even with the highly organised machinery available at St. Thomas's Hospital, 77·2 per cent. of the children were treated in their own homes, largely because there was no other means of dealing with them.

VI. SECOND SERIES OF CASES (under observation for several years).

THE NUMBER OF CASES OF RHEUMATISM IN CHILDREN OF 12 YEARS OF AGE AND UNDER FROM 400 FAMILIES UNDER OBSERVATION FROM 1923-4 ONWARDS.

1. *The incidence of cardiac involvement.*

During the investigation for the Child Life Committee of the Medical Research Council, 400 families each containing at least one child attending the hospital for rheumatism were investigated. This investigation was begun in 1923, and the children were not selected in any way except as cases of undoubted rheumatism. At the same time, not every case of rheumatism attending in the department during the years 1923 or 1924 was investigated. Cases of children living beyond a certain radius or on the north side of the river, cases of adopted children whose family histories were unobtainable, and surplus cases when the sample of 400 had been obtained were not investigated. The cases were earmarked for investigation each week in such numbers as could be undertaken at the time, and there was no selection of any particular type of case.

The medical records of these children, together with those of such of their brothers and sisters who were under 12 years of age, and also under treatment at the hospital for rheumatism, have been examined and the progress of the disease up till the time of the last attendance noted.

The classification of the cases is difficult as a child may have suffered from various manifestations of the disease at different times and so cannot be satisfactorily placed under one heading. In making the following attempt at classification, the plan has been adopted of dividing the cases into three groups.

1. Under the heading of Rheumatism, those cases who were brought to hospital suffering from some definite form of rheumatic manifestation such as rheumatic fever, organic heart disease, chorea or nodules and who gave a *history of onset with pains*.

2. Under the heading Chorea, cases where the child was brought to hospital definitely for chorea itself.

3. Under the heading of Rheumatic Carditis, those cases where the child is brought to hospital for symptoms which result from a cardiac lesion, where the rheumatic history, if present, is very

indefinite. Such cases are often those of children sent by the school medical officers, the lesion, hitherto unsuspected, having been discovered at the routine inspections, or of children brought up on account of general malaise, in whom the heart condition was quite unsuspected by the mother.

With the possible exception of a few such cases as those of group 3, it cannot be too strongly emphasised that the most striking point in the histories of these rheumatic children is the fact that they gave a history of joint pains or "growing pains" at some period prior to the appearance of definite manifestations of attack by rheumatism, in the vast majority of cases. This complaint on the child's part, unless the pains are of great severity, is often disregarded by the mother. They are put down to natural "growing pains," the effects of chill, or often thought to be imaginary, and it is not till the disease flares up and becomes severe that the child is brought for treatment, by which time often irreparable damage is done.

The number of boys and girls in each of the groups described above and the condition of the heart are shewn in Table 2.

TABLE 2.

Shewing the number of children in each group of rheumatic diseases and the condition of the heart in a series of 473 cases under twelve years of age from families under investigation in 1924-5 at St. Thomas's Hospital.

Under treatment for	Condition of the Heart	Number of Cases		
		Male	Female	Both Sexes
Rheumatism ..	With definite lesion	37	41	78
	With suspicious signs	33	44	77
	Normal	59	68	127
		129	153	282
Chorea	With definite lesion	4	8	12
	With suspicious signs	10	23	33
	Normal	38	57	95
		52	88	140
Rheumatic carditis	.. .. .	27	24	51
	Total number ..	208	265	473

From this table it appears that 68 boys, or 32·7 per cent., 13 girls, or 27·5 per cent., in all 141 children, or 29·8 per cent., had definite cardiac lesions. Further, 43 boys, or 20·7 per cent.,

67 girls, or 25·3 per cent., in all 110 children, or 23·3 per cent., had hearts with suspicious signs as described on page 52.

2. *The number of relapses sustained.*

It was not possible to give an account of the relapses sustained by the children who attended in 1926, as they have not all of them been under supervision long enough to provide the data. It was found that in 257 of the 473 children from the second series investigated, the previous history and the period under treatment exceeded two years. The range of the history and period under treatment combined are shewn in Table 3.

TABLE 3.

Shewing the number of years over which the rheumatic history or treatment extends in a series of 104 boys and 153 girls.

Number of Years	Boys	Girls	Both Sexes
2	46	47	93
3	25	52	77
4	19	28	47
5	6	13	19
6 or more	8	13	21
Total number ..	104	153	257

The remaining 216 cases have been known for less than two years and of them it is not possible to say anything definite. They are discussed more fully later in the Report.

To define a relapse in the progress of these children is difficult. It is comparatively rare to find in examining the records of these children any evidence of a clear period of absolute recovery. In fact the difficulty is such that for practical purposes it seems better to regard rheumatism in children as constituting a chronic progressive disease rather than as an acute disease with a tendency to relapses. The picture presented by the histories is that of periods of remission in the severity of the symptoms, during which periods however, there may be complaints of pains of varying severity. For this reason it is extremely difficult to decide when one attack has ended, and another has begun.

In selecting for analysis a sample of children who have been under observation or treatment for any length of time it must also be remembered that they tend to be the most lingering cases and that those who apparently recover more quickly may cease attending. In this instance, however, the possible selection of the severe cases was not so great as might be expected, as attendance sheets were kept of all children attending the Rheumatism Clinic and absentees were sent for.

The following types of case present special difficulty in estimating the actual number of relapses :—Those suffering from rheumatic carditis. It can never be said that these children have com-

pletely recovered and it is very difficult to *tabulate* in any way the improvement or otherwise in the state of the heart. These cases, unless there has been a history of an acute attack of arthritis or of chorea in addition to the heart condition, have, therefore, been shewn as having one attack only, which of course, is no index to the severity of the disease.

3. Cases of Chorea.

There are some cases of Chorea with well-defined attacks (often occurring at the same season every year, or coincident with some emotional upset), but there are also a large number who continue to attend for prolonged periods with fluctuating conditions as regard the severity of the symptoms and intervening periods of latency accompanied by rheumatic pains. In this type of case it is hard to say when the original attack has ended and a relapse set in. The records of this type have been carefully scrutinised and relapses have been recorded only when the chorea has become apparent after the movements have been noted as absent. It is possible that the numbers arrived at are an understatement of the number of relapses, as some may have occurred during periods of absence from attendance.

In all cases, for the purpose of estimating the number of relapses, the history of each has been examined from the first manifestation of the presence of rheumatism, and any further manifestation of a different form of the disease has been counted as a relapse. Thus, if a child originally attended for rheumatism with marked pains and stiffness in the joints, and after a period of treatment developed chorea, rheumatic fever or carditis, these further developments, *if they occurred at separate times*, are noted as relapses.

With the reservations described above, the number of relapses suffered by the 257 cases who have been known for over two years is shewn in Table 4.

TABLE 4.

Shewing the number of relapses sustained by 257 children under observation for a minimum period of two years (average 3·2 years) at St. Thomas's Hospital.

Number of Relapses	Boys	Girls	Both Sexes
No further manifestation or acute attack	19	19	38 or 14·7 per cent.
One relapse	42	54	96 „ 37·3 „ „
Two relapses	28	41	69 „ 26·8 „ „
Three relapses	11	27	38 „ 14·7 „ „
Four relapses	4	9	13 „ 5·0 „ „
Five relapses	—	3	3 „ 1·5 „ „
Total number under observation	104	153	257 100·0

From this table it will be seen that in 38 cases, or 14·7 per cent., no relapse as such was observed. Among these were 13 cases of rheumatic carditis of varying severity where the question of relapse, as already stated, does not arise, 6 cases of first attacks of chorea who had had no further manifestation, and 19 cases of rheumatism who were apparently controlled by treatment. 96 children, or 37·3 per cent., had had one relapse and 123, or 44·0 per cent., had two or more relapses, during a minimum period* of two years and an average period of 3·2 years.

Of the final result of treatment it is not possible to say anything as yet. In order to estimate the ultimate prognosis it would be necessary to re-examine the entire series at some future date. Three girls and 4 boys in this series are known to have died as a result of the disease, but it is possible that some deaths may have occurred which have not been notified to the hospital, so that no figures of the actual mortality can be given without further investigation.

In the 400 families under review 216 cases were not under observation for any definite length of time. Some ceased to attend, others have been drafted to other departments of the hospital on account of age and a few cannot be traced to their last attendance. 22 boys and 28 girls, in all 50 children, had one or more relapses during the time they were under observation. The remaining 166 cases were of the following types :—

- 57 of chorea, first attacks with no further manifestation while known.
- 36 of rheumatic carditis with no other manifestation while under observation.
- 20 of rheumatic fever, first attacks who did not return for treatment after the acute symptoms had disappeared.
- 54 cases of rheumatism with subacute symptoms (some with dilation of the heart and suspicious murmurs) who ceased to attend but were not discharged as well.

It is impossible to be definite as to the progress of the disease in these cases. Their failure to attend might be ascribed to recovery ; on the other hand they may have gone to other hospitals or to private doctors. They have, at all events, not re-appeared in the Children's Department at St. Thomas's Hospital up till January, 1927, and it is noteworthy that 54, or nearly one-third, are now over age for the Children's Department and could not return there.

VII. SUMMARY AND CONCLUSIONS. OUT-PATIENTS.

1st Series—Cases of 1926.

The incidence of rheumatism in the Children's Department, which deals only with children up to twelve years of age, during

* Mackie has shown that only 57 per cent. of relapses were found to develop in a period of four years following the first attack of rheumatic fever. A.M. Jl. Med. Sci., 1926, Aug., p. 220.

the year 1926, including 19 children admitted to the wards as emergency cases through the Casualty Department, was found to be 508 cases, of whom 231, or 45·5 per cent., were boys and 277, or 54·5 per cent., were girls.

Of these children 111, or 21·9 per cent., had undoubted cardiac lesions and, in addition, 108, or 21·3 per cent., had a cardiac condition suggestive of organic damage.

The difficulty of treating the disease in children living at home and for the most part under conditions which preclude their having the necessary rest and quiet appears so great that it is obvious that those cases requiring rest in bed cannot be adequately nursed in their own homes and must be admitted to some institution. This is particularly necessary where more than one child in the family is affected.

Accommodation for cases of rheumatism appears to fall far short of the demand. 34 cases were admitted to St. Thomas's Hospital and 14 to the infirmary or other hospitals during acute stages of the disease. 68 children with more chronic conditions were sent to special institutions or convalescent homes. 392, or 77·2 per cent., were treated as out-patients at home, many of whom would have been recommended for admission to institutions had accommodation been obtainable when required.

2nd Series (Prolonged observation).

In a series of cases from 400 families under special observation from 1923-4 onwards, the number of children of twelve years or under found to have attended the hospital for rheumatism was 473, of whom 208, or 43·9 per cent., were boys and 265, or 56·1 per cent., were girls.

Of these children 141, or 29·8 per cent., had cardiac lesions, and 110, or 23·3 per cent., had a cardiac condition suggestive of organic damage. This percentage is significantly higher than that found in the 1926 series, which contained a higher proportion of early cases.

It was found difficult to estimate the relapses sustained by these children owing to the fact that the disease appeared to be chronic and indefinitely progressive in its course.

In 38 out of 257 cases under observation for two years or more, or 14·7 per cent., no relapse as such was observed, but in 19 of these cases only could it be considered that the disease was controlled. 96, or 37·3 per cent., had had one relapse, and 123, or 44·0 per cent., had had two or more relapses.

Of the end results of treatment nothing can be said without re-examination of the children at some future date.

GENERAL CONCLUSIONS—OUT-PATIENTS.

Though, as has been said before, figures based on cases attending a hospital probably tend to show up the darkest side

of the picture of the effects of rheumatism on child life, the following facts are striking :—

- (1) that there were 508 children (of up to twelve years only) attending in one department of a single hospital in one year suffering from the disease ;
- (2) that of these 21·9 per cent. already had cardiac damage and, in addition, 21·3 per cent. symptoms of threatened cardiac involvement ;
- (3) that of a sample of children whose rheumatic history was known to extend over two years or more 44·0 per cent. had had two or more relapses ;
- (4) that in the longer known sample, consisting of 473 children, the amount of cardiac damage was greater than in the 1926 series, which contained a greater proportion of early cases.

These facts tend to show the urgency of the provision of means for the early detection of cases of rheumatism and for their prolonged treatment. The difficulty of nursing them in their own homes has been pointed out, and the impossibility of securing admission to an institution in all cases requiring rest in bed under present conditions is obvious. At present only the most urgent cases from the medical or social point of view can be sent for institutional treatment, and that only after unavoidable delay and much negotiation. These cases are not the most hopeful ones. Only when provision is made to meet the full demand will the earlier or less severely crippled cases, which cases best repay preventive treatment, have adequate facilities for treatment under conditions which will at least give them some chance of recovery.

In conclusion, it is desired to express indebtedness and thanks to Dr. Jewesbury for his kind permission to utilise the medical notes of the Children's Department, to Dr. Forest Smith, who has kindly advised as to the correct classification of the cases with cardiac involvement, to Miss Cummins, Lady Almoner, St. Thomas's Hospital, for giving access to her case-papers and records, and to her assistant in the Children's Department, Miss Lord, for her help in tracing out the social histories of the children.

VIII.

Focal Infection.

There has been much discussion upon this subject into which space will not allow us to enter. The controversy arises partly from the fact that some observers have investigated series which consist entirely of cases of rheumatic fever, whilst others have included cases of rheumatic infection of much wider significance. Again, whilst some observers have used control series of healthy persons, others have used as controls series of patients with other diseases. Not unnaturally the conclusions thus arrived at have been conflicting.

A search for the focus of infection in such a disease as acute rheumatism, closely associated as it is with the streptococcus, would naturally be directed to the nasopharynx and its connexions, to the teeth, and to the intestinal canal. Work upon the third site has so far proved inconclusive and few observers seem inclined to believe that dental sepsis in children is a cause of acute rheumatic infection, although in later adult years dental sepsis is perhaps the most common focal infection in certain chronic joint diseases, which though termed "rheumatic" are probably unrelated or only distantly related to acute rheumatism. As to the causation of the first attack of rheumatic infection, it is, however, generally agreed that tonsillar infection with or without a subsequent cervical adenitis is of prime importance.* Careful comparisons of the aetiological aspect in series of rheumatic and non-rheumatic control patients have been made by many observers (e.g., Lambert† and Mackie‡). Mackie found infected tonsils in 58·8 per cent. of his rheumatic fever patients compared with 27·5 per cent. of his controls. Lambert, using acute pneumonia patients as a control, found the proportions of infected tonsils only 25·5 per cent. among acute rheumatism patients (all ages) to 17 per cent. in acute pneumonia patients. Mackie comes to the conclusion that focal infection plays a direct rôle in the etiology. Tonsillar infection was found to be more than twice as prevalent in the rheumatic fever patients as in 400 non-rheumatic controls. Only 112 of Mackie's 366 patients were under 15 years.

In the Ministry of Health inquiry§ only 2 per cent. of the patients (all ages above 16) with acute rheumatism had had their tonsils operated upon by any operation, although over 50 per cent. had obviously enlarged tonsils. Contrast with this a young community such as Eton College, where rheumatic infection is conspicuously absent despite a low-lying riparian situation; here there has been no case of acute rheumatism and only one of chorea in the 19 years up to 1923¶. Here, in addition no doubt to great advantages in nurture, there is a high percentage, amounting in a recent sample to nearly 70 per cent.,|| of boys whose tonsils have been removed before they enter the College at 13–14 years. At another well-known public school, of 184 boys in three houses 71, or 39 per cent., had had their tonsils enucleated before entering the school at 13–14 years of age. Such facts as these, whilst not strictly evidence, have a suggestive bearing on the subject.

In the recent Medical Research Council's investigation** it was found that the proportion of healthy throats is definitely smaller

* See page 36.

† Jl. American Med. Assoc., 1920, p. 192.

‡ Am. Jl. Medical Sciences, 1926, Aug., p. 199.

§ Report No. 23, 1924—Incidence of Rheumatic Diseases.

¶ Attlee, Brit. Med. Jl., 1923, October 20th, p. 709.

|| Personally communicated.

** "Social Conditions and Acute Rheumatism", Special Report Series No. 114, p. 39.

in rheumatic children than in their non-rheumatic brothers and sisters, and than in children of normal families.

The Value of Tonsillectomy.

This question must be considered as two different, though closely related, questions :—

- (1) does tonsillectomy tend to reduce the risk of the rheumatic infection ?
- (2) does tonsillectomy after the first attack tend to prevent recurrence, and after the heart has been affected does it tend to prevent the heart affection from becoming a permanent condition ?

Of these questions the first is perhaps the harder to answer, as by the time the tonsils are sufficiently large or suspicious to be operated upon, the infection has probably travelled beyond them. A large number of cases have been recorded where the onset of rheumatic fever has occurred some years after an apparently satisfactory enucleation of the tonsils. Thus among 907 rheumatic members of rheumatic families in the Medical Research Councils series 60 had developed rheumatism at varying periods after apparently satisfactory enucleation. Chorea was the predominant subsequent manifestation (66·7 per cent.). There seems little doubt that the operation has less protective value against chorea than against acute rheumatism.

Poynton* has summarised the answer to the first question thus—

- “ (1) I believe the tonsils to be an important site of infection.
 (2) I know that skilled enucleation will not prevent a first attack of rheumatism and acute carditis of extreme severity occurring some years later.
 (3) I know also that an acute and crippling attack of carditis may directly follow removal of the tonsils in the rheumatic.
 (4) I hold that the successful removal of unhealthy tonsils is a valuable prophylactic step if, undeterred by exceptions, we view the problem on broad lines.
 (5) I believe every case must be considered as an entity, and do not favour routine action.

Miller† believes that “ Probably still more favourable would be the group operated on in the prodromal stages, before an acute rheumatic attack has declared itself. To my mind the early operation is probably one of the many factors making rheumatism rare in private practice as opposed to hospital practice.”

Kaiser,‡ working on two precisely parallel series of 1,200 children each, both series consisting of children over 5 who

* Brit. Med. Jl., 1925, October 31st, p. 790.

† Brit. Med. Jl., 1926, July 3rd, Supplement, p. 20.

‡ Jl. Amer. Med. Assocn., 1924, 82, p. 759.

required tonsillectomy, but one series made up of patients who underwent the operation, and one series of those who refused operation, re-examined both series after three years. The results with regard to rheumatic infection were not striking :—

“Chorea had existed in seven of the children not operated on, and in eight of the group operated on. Six of the eight children developed it since the removal of the tonsils. A history of rheumatic pains was obtained in equal numbers in the two groups. Cardiac disease was based on the physical examination. In the control group, fifty-two children presented evidence of cardiac disease; in the group operated on there were forty-four cases, of which number thirteen had developed since the operation. With the decided lower incidence of sore throat in the group operated on, it is hoped that cardiac disease also will be less likely to develop in these children as years go on.”

Nevertheless his conclusion was favourable.

“The presence of positive or suspected evidence of the rheumatic syndrome manifestations, rheumatism, chorea and heart disease, is a definite indication for tonsillectomy in view of the lessened incidence of heart disease in the group operated on.”

Does tonsillectomy after the first attack of rheumatism tend to prevent recurrence, and after the heart has been affected, does it tend to prevent the heart affection from becoming a permanent condition? This question is somewhat easier to consider than the first, for at least we start with the definite knowledge that infection has already become systemic. Here again great differences of opinion have been expressed. Hunt and Osman* at Guy's Hospital found recurrences in 53 per cent. of 66 child patients with acute rheumatism in whom the tonsils had been completely enucleated, whereas in 78 patients whose tonsils had not been enucleated only 42 per cent. had recurrences of acute rheumatism. Ingerman and Wilson, taking rheumatic manifestations rather than strict acute rheumatism, found recurrences in 76 per cent. of child patients who had been operated upon and in 80 per cent. of child patients whose tonsils had not been enucleated.

Miller† on the other hand finds that the result of tonsillectomy “eminently encouraging.” Speaking from the examination of a series of 45 children whose tonsils had been enucleated and comparing with a series of 133 children not operated upon, “in many cases,” he says, “sore throats, arthritis and carditis, in all its forms are found to be greatly diminished in the tonsillectomised children. Chorea on the other hand appears to be totally uncontrolled by previous tonsillectomy. The great majority of first and later in-patient attacks of rheumatism occurring in tonsillectomised children consists of chorea, usually uncomplicated.”

St. Lawrence‡ observed 85 children, all of whom had had

* Guy's Hospital Reports, Vol. 3, 4th Series, 1923, p. 383.

† Brit. Med. J., 1926, July 3rd, Supplement, p. 19.

‡ J. Amer. Med. Assoc., 1920, 75, p. 1035.

rheumatic fever or chorea, for an average period of $3\frac{1}{2}$ years after complete removal of the tonsils. He found that whilst half the patients with chorea suffered recurrences, only 16 per cent. of the rheumatic fever patients had recurrences, so that of the whole of his 85 children 60 per cent. remained free from recurrence for $3\frac{1}{2}$ years, and he considers that "complete enucleation of the tonsils would seem to be the most important measure at present available for the prevention of acute rheumatic fever and the appropriate rheumatic manifestations."

H. S. Starling* strongly advocates tonsillectomy in every case in which there is the least suspicion that the tonsils may be infected. He emphasises particularly two points, first that in the course of rheumatic infection, the earlier the tonsils are removed the greater is the benefit derived; and secondly, that in order for the operation to be effective, every particle of tonsillar tissue should be removed. A mere tag or stump left behind may be as potent a source of infection as were the whole tonsils before removal.

Mackie's† conclusion is that the complete removal of the tonsils when evidence of infection is present, together with appropriate treatment of other foci of infection, seems to reduce, but not to remove, the incidence of recurrences of rheumatic fever. Mackie's article (an admirable example of how much may be revealed by long and careful observation of apparently familiar facts, when that observation is combined with clear thinking and lucid expression) shows that (in general and without reference to tonsillectomy) the length of time between the original attack and the first recurrence is much longer than is usually appreciated.

He found that only 57 per cent. of first recurrences were found to develop within a period of 4 years following the first attack of rheumatic fever, and he justly points out that this would seem to be an important factor to be considered in weighing the true worth of any therapeutic or prophylactic attack upon the problem of rheumatism.

A. P. Thomson,‡ from his clinical results in convalescent children, lays great stress on the importance of early complete tonsillectomy in the prevention of the recurrence of acute symptoms and in the prevention of permanent carditis.

The length of time, however, which, according to Mackie, must necessarily elapse before the danger of the first recurrence can be considered to be over, renders necessary the re-examination of almost all our conclusions on this aspect of the problem. In the meantime and in spite of the many somewhat disappointing results, the truth probably is that tonsillectomy (if practised early enough and if completely performed) is of great value not only as a prophylactic against a first attack of acute rheumatism, but also that it is often an effective preventive of recurrence, and

* Starling, Guy's Hospital Reports, Vol. 3, 4th Series, p. 388.

† Am. Jl. Med. Sciences, 1926, August, p. 220.

‡ Thomson. "A Study of Rheumatism in Children," Birmingham Medical Review, Vol. I., No. 7. New Series. 1926.

that it also has a highly beneficial effect in preventing rheumatic carditis from resulting in permanent damage. That so many cases have occurred where it has not prevented the first attack of rheumatism is probably due, in part at least, to the fact that by the time a child of the hospital or elementary school class is brought for tonsillectomy, the condition has existed so long that infection has already reached the glands in the neck and other sites and has given rise to a systemic infection which may blaze up at any time when resistance becomes low, despite the complete removal of the tonsillar focus of infection. Even if this be so, however, the removal of infected tonsils is almost certain to prove beneficial, and examples of any harm following the operation are exceedingly rare. In our opinion the indications should be read not as showing that the operation is of doubtful utility, but that it is not performed early enough in many cases.

PART III.

TREATMENT.

IX.

The Treatment of Children convalescent from Acute Rheumatism or Chorea, and of Children suffering from sub-acute Rheumatism from the Public Health Standpoint.

Into the clinical aspect of the treatment of acute rheumatism this Report, dealing solely with the preventive side of the problem, does not enter. But the convalescence of children who have suffered from acute rheumatism and chorea, and the treatment and care of children suffering from sub-acute and chronic rheumatism are alike practical problems of preventive medicine. How to prevent recurrences of the acute disease, how, if possible, to avoid cardiac complications, and in that great majority of cases where carditis has supervened, how to prevent extension of the heart lesion have all to be considered. Treatment must be directed to the elimination of all possible sources of infection, to the building up of the patient's resistance, and in cases of established heart disease, to the re-education of a damaged heart in order to enable it, without increasing its disability, to respond to the demands of a normal life. So also to preventive medicine belongs the problem how to adjust the conditions of school life to suit the limitations of the rheumatic or the cardiac child, and how to enable that child to obtain such benefit from education as will fit him to compete in after years with his more fortunate companions in the struggle of life.

Both for the child convalescent from acute rheumatism, and for the child with subacute rheumatism, as well as for the child with active endocarditis, the first essential of treatment is *rest*.

Rest has been deemed essential for heart disease since the earliest times. In the Ebers papyrus, which is not later than the

16th century B.C., it is stated "that the heart during such disease (inflammation of the heart) must be made to rest to some extent if it be possible." To secure rest for the unresting heart can only be accomplished by recumbency.

This doctrine was given a new emphasis by Sibson in 1877, with his demonstration of two series of cases, one treated by his "rigid system of rest" the other not so treated, and since his work all have at least rendered lip service to the principle. Caton,* in his Harveian oration of 1904, expressed the fundamental principles upon which that doctrine rests.

"I believe, however, that by far the most important factor in the abortive treatment of endocarditis is rest, rest for many weeks, the slowing of the heart, the lengthening of the diastole which is the only rest time possible, the careful avoidance of high blood pressures, which the weakened and softened valve cusps cannot sustain without peril, and the diminution of the volume of the blood to be moved.

"Only then, when functional activity is minimised, can we hope for repair of mischief, re-formation of destroyed endothelia and absorption of effusion in the valve cusps. Moreover, repair is only possible during the early stages of endocarditis; later the mischief is permanent—unalterable by any form of treatment.

"I submit that these measures are rational, their objects being by affording rest to give opportunity for the exercise of the *vis medicatrix naturae*, which is our sheet anchor, nay, indeed, to stimulate that natural reparative process which alone can effect restoration."

In the same year (1904) R. Hutchison† said "So that what one has to preach about the treatment of rheumatism is the necessity of rest. One would like to put these cases in double long splints and keep them on their backs for six months! I am sorry to say that of necessity in such a hospital as this (the London) one has to set a bad example in this matter, for we cannot keep these cases in long enough, but you have to impress upon the parents that they absolutely must allow prolonged rest so as to prevent the heart becoming permanently damaged later on. If you insist upon prolonged and absolute rest and at the same time use salicylates and iodides for the local affection, applying blisters over the heart when there are signs of pericarditis you will do a great deal to prevent your patients becoming permanently crippled, and you will consequently diminish the amount of cardiac disease which one sees in grown-up persons."

Mackenzie‡ in 1908 laid down "that the patient should be kept strictly in bed until there is assurance that the condition is quite abated until the rate is quite normal, even though six months may elapse before this result is brought about." A year

* Lancet, 1904, i, p. 1774.

† "Lectures on Diseases of Children," 1st ed., p. 164.

‡ "Principles of Diagnosis and Treatment of Heart Affections," 2nd edit., p. 147.

before G. A. Sutherland* had recommended six months' rest in bed or longer if necessary, followed by sanatorium treatment for one or two years.

Undoubtedly, whilst there is any evidence of active infection or progressive involvement of the heart, and for a period of at least three weeks subsequent to the cessation of any such evidence, complete rest in bed is essential. But if proper facilities are available at the end of this time, if adequate supervision and all the surroundings are favourable, recent opinion is in favour of substituting "graduated rest" for complete rest, and so gradually allowing the child to resume carefully graduated and supervised minor activities.

But in any case "complete" rest should be continued for three weeks after (1) the pulse rate and temperature have returned to normal, (2) anæmia has disappeared and (3) the heart signs are unchanged.

The essentials of treatment then appear to be :—

- (1) Complete rest until three weeks after symptoms have ceased.
- (2) Removal of focal sepsis if not already carried out.
- (3) Graduated resumption of activity "graduated rest."
- (4) Country air and perfect environmental conditions.
- (5) Constant medical and nursing supervision.
- (6) Special educational arrangements.

For such a regimen for children of the elementary school class, institutional treatment is obviously necessary, and we must now consider the various types of hospitals and schools and the part they play in the treatment of convalescent and sub-acute rheumatism, and in the prevention of cardiac complications. They will be dealt with under the following headings :—

- (a) Special Homes for Rheumatic and Cardiac Children.
- (b) Ordinary Convalescent Homes.
- (c) Day Open-Air Schools.
- (d) Residential Open-Air Schools.
- (e) Physically Defective Schools.

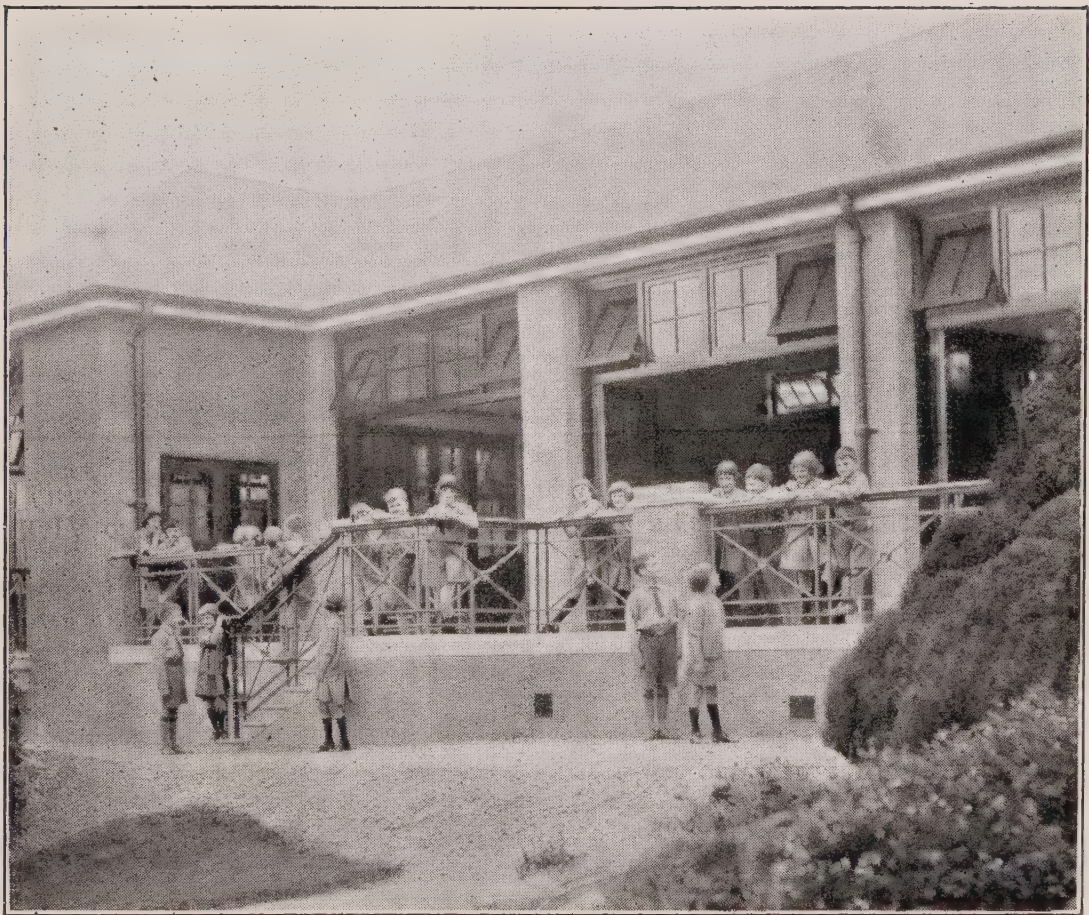
Special Residential Schools for Rheumatic and Cardiac Children.

The need for special residential schools where rest and recreation are strictly controlled, and where expert medical advice and periodic supervision are available has been suggested for some time past, though it is only during recent years that such institutions have been opened.

The Chief Medical Officer, in his Annual Report for 1913 to the Board of Education, wrote: "Perhaps the best method of dealing with children with heart disease is to send them to a residential

* "Diseases of Children," 1907.

VI.



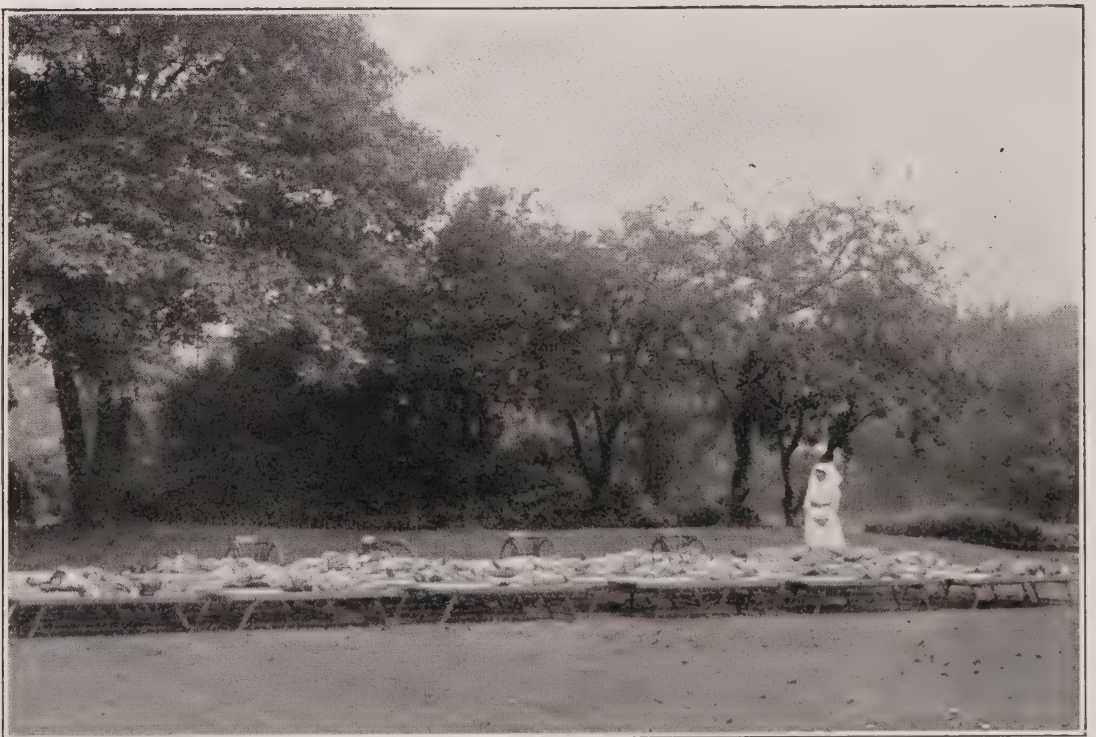
*One of the three semi-open air class rooms of the NEW WING, 30 or 32 children in each, showing the sliding doors open. Note the school "uniform" and the ventilated spaces under the floor.
Baskerville Residential School.*

VII.



Interior of one of the three semi-open air class rooms of the new wing, showing special reclining couches for half the children. (See also VI.).

VIII.



Rest in the grounds. The couches have backs which can be raised from a semi-prone position similar to the schoolroom couches. Baskerville.

school for a period of prolonged treatment The treatment of heart disease has not yet been adequately considered by Local Education Authorities, but it is hoped that ultimately the residential school will have its place in any schemes which may be formulated." The Invalid Children's Aid Association were pioneers in providing this type of school foreshadowed in Sir George Newman's Report. Under their auspices the Edgar Lee Home at Willesden was opened in July, 1919, and the "Kurandai" Home at Hartfield, Sussex, in April, 1924. Early in 1923 the Horsfall Wards of St. Mary's Home, Broadstairs, were set aside for the treatment of rheumatism, carditis and chorea occurring in children. The Baskerville Residential School, Harborne, Birmingham, which was opened by the Local Education Authority in September, 1921, as a residential open-air school for physically defective children, is now reserved for the admission of sub-acute and chronic cases of rheumatism. Birmingham is therefore the first Education Authority to provide special accommodation for this type of child. The total number of beds provided by these homes is shewn in the table below :—

	No. of Beds			
Edgar Lee Home	22 (Boys only)
*Kurandai Home	50 (Girls and small boys)
St. Mary's Home	26
Baskerville Home	90 (42 boys, 48 girls)
Total				188

In the light of the so-far limited experience gained by the working of these institutions it is necessary to review briefly the main features which should characterise their domestic, medical, and educational arrangements.

SITE AND BUILDINGS.

The site should be elevated and dry, near to and accessible from the district or town from which cases are drawn. The question as to whether the buildings should be of open-air type is still a matter for experiment. Possibly the compromise which exists at Baskerville, where the children sleep in ordinary wards, but attend school in rooms which may be completely opened along one side, is the best present solution of the problem. There should be adequate accommodation for school rooms, recreation rooms and a dining room. A shed in which the elder boys may be instructed in manual work is to be strongly recommended on account not only of the educational advantage so afforded, but also of the suitability of such work for the cardiac child. A large garden, in which lessons can be given in the open air and games can be played, is essential.

* Note.—The Kurandai Home, Hartfield, Sussex, has now been vacated in favour of a more convenient house near Bromley, in Kent, where beds for 30 girls will be provided in the first instance. It is hoped to increase the accommodation later.

SELECTION OF CASES.

The cases admitted to the Homes under the Invalid Children's Aid Association are drawn chiefly from the London hospitals, where they have either been treated as in-patients during the acute stages of the disease, or are attending the out-patient departments with chronic manifestations. In the majority of cases they are referred by the consultant physicians to the Association, who are also on the honorary staffs at various London hospitals. Similar arrangements hold for selection of cases for St. Mary's Home, Broadstairs.

In Birmingham more systematic selection can be secured. Cases are referred by the officers of the school medical service, or by practitioners, to the Children's Hospital, where they are seen by a consultant physician, who is also on the staff of Baskerville and who selects all cases for admission. The selecting officer, therefore, is in a position to follow up his patients, periodically examine them in the Home, supervise their treatment, and to determine when they should be discharged.

STAFFING.

(a) *Medical*.—All Homes have a consultant staff who visit periodically and advise on treatment of individual cases and general management of the institution. At St. Mary's Home, Broadstairs, and Baskerville, the consultant staff are in intimate touch with the work. They visit at least once a week, or at other times should they be called upon, and examine each patient at frequent intervals.

(b) *Nursing Staff*.—The number necessary for an adequate nursing staff depends very much on the nature, lay-out and general convenience of the premises occupied, and varies very much in the four Homes under consideration. Definite guidance cannot be laid down, beyond stating that a matron and two trained nurses, one for day, one for night, appear to be the least required. The remainder of the staff may consist of untrained nurses or probationers.

(c) *Teaching Staff*.—The regulations laid down by the Board of Education for staffing of Sanatorium Schools prescribe that there should be one full time teacher to 30 children. Education of the rheumatic child is a special problem, which involves individual instruction and care, and which has hitherto not received sufficient attention. As our experience increases, it may appear desirable to revise this standard, and to suggest that one teacher to 20 or 25 children is the minimum required. Small classes are particularly desirable for children liable to chorea.

(d) *Domestic Staff*.—Here, again, the staff necessary depends very much on the nature of the premises, and no definite statement can be made.

GENERAL TREATMENT AND HOSPITAL REGIME.

In reviewing the principles of treatment and management of patients, we can best quote M. O. Raven, who in describing the work at St. Mary's Home, Broadstairs, states :—

“ Their treatment has been the provision of fresh air, sunlight, warmth and good food, combined with an amount of rest varying in accordance with the amount of active infection ; this entails regular medical supervision and good nursing management to ensure contentment of the children while under considerable restraint.”

Rest as an important, possibly the most important factor, in the management of these cases, must, however, be enforced with due regard to the needs of each individual case.

A. P. Thomson,* Consultant Physician to Baskerville Residential School, in discussing this matter, states :—

“ In cases in which rheumatic symptoms, such as pain or choreic movements, persist or in which there is obvious recent cardiac damage, there is no difficulty, for clearly prolonged rest in bed is necessary. It is otherwise, however, with the more common type of case in which the rheumatic symptoms have not been clamant and the cardiac signs are equivocal. I am aware that it has been somewhat glibly said that rheumatic children should be kept in bed for at least six months on the ground that it never does any harm and may do a great deal of good, but I find it impossible to subscribe to this rather facile opinion. Prolonged rest in bed may never do any harm to a heart, but it may very seriously and adversely affect a child. Apart altogether from the loss of education and mental development that results from normal association with its fellows, a child condemned to invalidism for long periods is very apt to fall a prey to neurosis, which it is extremely difficult to get rid of later. One of the real problems at Baskerville School has been to prevent the children becoming self-pitying juvenile valetudinarians. To determine when a child may safely get up and begin its return to normal life, in the way that I have already indicated in describing the general control of these cases, I consider the best guides to be the temperature, the pulse rate, the physical signs in the heart, and the weight.”

Salicylates appear to be the only drugs in general use, and these only in case of rise of temperature. At Baskerville temperatures and pulse rates taken after 20 minutes' rest, are recorded of all children, night and morning. If any rise is recorded the child is kept in bed and salicylates are administered.

* A Study of Rheumatism in Children, Birmingham Medical Review, Vol. I, No. 7 New Series, 1926.

Children exhibiting any exacerbation of choreiform movements are also confined to bed, though salicylates are not given unless a rise in temperature accompanies the condition. All other children at Baskerville are submitted to the ordinary hospital regime, which may be taken as representative of that in other Homes.

The daily routine is as follows :—

7.20 a.m.	..	..	Rise.
8. 0 a.m.	..	..	Breakfast.
8.30 a.m.	..	..	Play, rest, household duties.
*9.20 a.m.	..	..	"Nerve rest."
9.30 a.m.	..	..	Prayers, singing.
10-12 a.m.	..	..	Morning school.
12. 5 p.m.	..	..	"Nerve Rest."
12.15 p.m.	..	..	Dinner.
1.0-2.15 p.m.	..	..	Resting, play, free walks in garden.
2.30-4.30	..	..	Afternoon school.
4.35 p.m.	..	..	"Nerve rest."
4.45 p.m.	..	..	Tea.
5.15-8. 0 p.m.	..	..	Recreation and bed. Time of going to bed depending on age or stage of convalescence.

TREATMENT OF SPECIAL DEFECTS.

Facilities should be provided at these institutions for the treatment of special defects, such as dental disease and enlarged tonsils and adenoids, which are intimately associated with the "rheumatic state." Great emphasis is now laid at Baskerville Home on the necessity for complete tonsillectomy in the prevention of carditis. Every patient is closely examined on arrival and if a previous tonsillectomy appears to have been incomplete, it is completed by actual dissection.

PHYSICAL EXERCISE.

Graduated exercise has an important place in the treatment of the cardiac child. To decide when the period of complete rest must end, and the re-education of the heart begin, is a matter which must necessarily be decided on the merits of each case. A safe rule, however, adopted by A. P. Thomson at Baskerville, is to insist on unchanging physical signs for three weeks before any exercise is allowed. When convalescence is complete the child is allowed moderate walking exercise. As a precaution against over exertion children in ascending stairs have to walk backwards. Later croquet and clock golf are allowed, but no games which involve chasing a moving ball. Finally, drill for periods of ten minutes and simple country dances with slow music are performed. At the Edgar Lee Home physical drill consists of breathing and trunk exercises only, and is taken in the open air for ten minutes each morning.

* "*Nerve rest.*"—All children sit or lie silent with their eyes closed for 10 minutes, and are taught to relax all their muscles. This procedure is particularly valuable in the treatment of chorea.

Dingley Fordyce, Consultant Physician to the Heswall Convalescent Home, the country branch of the Royal Liverpool Children's Hospital, has drawn up a scheme of graded exercises to suit various degrees of cardiac disability. It is as follows :—

O. Complete rest.

A. General massage with (1) deep breathing, (2) passive movements, (3) active movements, (4) resistive movements.

B. Child up half day.

C. Light gymnastics. Breathing exercises, easy limb, trunk and head exercises, exercises for co-ordination and rhythm, marching and running.

D. Games, ball games, relay races, leap frog, running maze, folk dances.

E. Heavy gymnastics.

EDUCATION.

The education at a Recovery Home should be modelled on the curriculum laid down for Schools for Physically Defective Children. Primarily it should be designed to give appropriate interest and occupation to the child mind. The taste for reading should be fostered, the formation of a good school library being an important means to this end. Certain subjects, such as geography and mathematics, may be taught practically in the garden; history by the acting of historical plays. Advantage should be taken of the garden for lessons in nature study.

For practical instruction the younger children can be taught Kindergarten occupations, drawing, colour work, needlework, knitting, raffia, cane and clay work. For the elder girls more advanced needlework and clothes making are suitable; for the boys, woodwork and bootmaking and repairing.

Special consideration with regard to the educational curriculum for cases of chorea should be given. The programme for such children is outlined by Thomson as follows :—

“At first the children are kept on stretchers; while movements are marked they are given simple handwork to do, such as winding wool, sorting handkerchiefs and other household linen on a suitable desk. For recreation they are encouraged to play cards, dominoes and draughts, to string beads and to arrange flowers; they also have picture books. A little later on they are allowed to paint and make artificial flowers and mats; they are also encouraged to knit, crochet and to do easy raffia and fancy work. Knitting is particularly good for the choreic cases. When the children are first allowed up they dust furniture and clear tables after meals. Usually one month elapses before they undertake formal school work, and on beginning the time is limited to one hour.”

Education is thus an important adjunct to medical treatment, though a note of warning must be given. Care must be taken not to engender a spirit of competition in the class work, and any attempt at "educational push" on the part of the teachers must be discouraged. Small classes and individual teaching are necessary if education is to be of physical benefit to the child.

PERIOD OF RESIDENCE AND DISCHARGE.

At Baskerville the usual practice is to keep children for three months after their condition as estimated by pulse rate, temperature, and cardiac signs has become stationary. This appears to be a sound general principle, though many factors, such as home conditions, locality from which the patient comes, may influence the length of stay.

The average duration of stay at the various institutions is given below :—

Edgar Lee Home	109 days.
Kurandai Home	127 days.
St. Mary's Home	6-8 months.
Baskerville Home	8 months.

AFTER-CARE AND RESULTS.

Treatment at a Recovery Home can only be considered as one event in a comprehensive scheme of care of the rheumatic child. The beneficial results achieved may be entirely lost unless the patient is "followed up" after discharge from the Home. Periodic examination of old patients by a consultant, preferably by the one under whose care they have been in the Home, is the ideal to be aimed at.

Such after-care and supervision is attempted by the Authorities of the four institutions under discussion.

On discharge of patients from their Homes, the Invalid Children's Aid Association notify the medical officer or authority responsible for their admission. Voluntary workers of the Association visit the patients' homes periodically, give advice, and, if necessary, induce parents to make arrangements for their children to attend out-patients' departments of hospitals. It is not possible, however, for the Association to make more comprehensive arrangements. Patients after discharge are scattered, and though many live in London, others may return to rural districts where the facilities for visiting, and for attending hospitals are limited. The Edgar Lee Home holds a re-union for old patients once a year, and the consulting physicians are present to examine cases and give advice. In 1926, 110 old patients were invited, and 38 attended. Of these 35 were in a stationary condition, three, one of whom has since died, were definitely worse than when they left the Home. M. O. Raven attempts to keep in touch with his old patients by holding a clinic in London once a year. In the *Lancet* of October 3rd, 1925,

he published the results found at the after-care clinic held in May 1925:—

“Of 75 cases discharged before the spring of 1925, six had died all were cases of severe and advancing cardiac rheumatism and were, practically speaking, sent home to die. Of the remaining 69 cases just two-thirds were re-examined, and of these 46 cases 15 showed, or had shown, subsequent signs of active rheumatism, chorea or carditis. In eight of these there had been fresh acute rheumatism shortly after returning home; in two cases mitral disease had slowly developed along with continual chorea; in two cases there was progressive evolution towards mitral stenosis in spite of reports of perfect health from the patients and their mothers; and in three cases there had been chorea off and on for from one to two years without any carditis. The remaining 31 cases had held their own and had had no relapse.”

At Birmingham there are more favourable opportunities to secure a comprehensive scheme of following up children. They are drawn from a circumscribed area, they are admitted to Baskerville under the auspices of the Local Education Authority, and the machinery of that Authority which exists for carrying out their medical work can be applied to the problem of after-care of rheumatic children.

Cases discharged from Baskerville are reported to the School Medical Officer. Their after-care and supervision are undertaken by nurses and medical officers of the Education Authority, or in special cases by the consultant himself. This supervision continues throughout school life. Attempt is made to keep in touch with those who have attained a post-school age, and Thomson holds an occasional clinic at the Education Office for the purpose of examining and advising the old patients of Baskerville. Their condition as regards employment suitable to their disability is reported to the Juvenile Employment Committee. At the last clinic of this kind of old patients 14 out of the 16 old patients written to appeared for examination.

Of 58 patients who have left Baskerville for more than a year and who are still in touch with Thomson, 36 (62 per cent.) he classifies as “A,” that is to say, they have normal hearts or signs of slight cardiac damage which persists unchanged; 15 patients (26 per cent.) shew either some deterioration of the heart condition or have had a relapse of rheumatism; 7 (12 per cent.) are dead. Thomson considers that future figures will show an improvement in consequence of the wider experience gained and of the recognition of the value of early and complete tonsillectomy.

Residential Schools of Recovery in America.

A short account of a similar residential home in America, summarised from the Year Book of the Mineola Home, New York, for Cardiac Children 1921–1923 may be given.

The Home admits both sexes between the age of 8 and 16 years, and the maximum number of cases in residence at any one time

during 1921-1923 was 56. The types admitted are children with heart disease, slight or severe, with "possible heart disease" (*i.e.*, those with abnormal physical signs in the heart but without concurrent symptoms), and with "potential heart disease" (*i.e.*, those exhibiting rheumatic manifestations). Children are accepted only after examination and recommendation by physicians of a cardiac clinic. So far as possible children with remedial defects are not admitted until after the correction of their defects.

There is a consultant medical staff whose members visit the home periodically and a panel of local medical practitioners, who are available for emergencies.

Much regard is paid to the importance of exercise in the treatment of patients. On admission all children are tested for exercise tolerance, and the physical exertion which they may undergo is graded in accordance with their disability. No child is allowed exercise if it shows abnormal circulatory or physical reaction. As convalescence proceeds and exercise tolerance improves, 30 minutes exercises, graduated for each child and given under a trained instructress, gardening, and games such as croquet, handball, and pushball are allowed. The daily programme is outlined as follows :—

6.30 a.m.	..	..	Rising bell.
7. 0 a.m.	..	..	Strip beds ; fold bedding ; hoop mattresses.
7.15 a.m.	..	..	Breakfast.
7.40 a.m.	..	..	Temperatures and general personal inspection of all children.
8. 0 a.m.	..	..	Salute to flag ; singing.
8.15- 8.45 a.m.	..	..	Setting-up exercises (out of doors if possible).
8.55-11.45 a.m.	..	..	School (10.30 extra nourishment).
11.45 a.m.-12.15 p.m.	..	..	Dinner.
12.15- 1.30 p.m.	..	..	Rest in chairs (out of doors permitting).
1.45- 3. 0 p.m.	..	..	School.
3. 0 p.m.	..	..	Milk, bread and butter.
3.10 p.m.	..	..	Temperatures ; general personal inspection of all children by two nurses.
3.30- 5.30 p.m.	..	..	Out of door exercises ; base ball ; basket ball ; swings ; tether ball ; croquet ; supervised hikes, etc.
5.30 p.m.	..	..	Supper.
6. 0- 6.30 p.m.	..	..	Distribution of mail ; letter writing.
6.30- 7.30 p.m.	..	..	Evening Programme. Dancing classes, sewing classes ; story reading, etc.
7.30- 9. 0 pm.	..	..	Free play for all.
7.50 p.m.	..	..	Younger children retire.
8.50 p.m.	..	..	Elder children retire.
9.30 p.m.	..	..	All lights out.

Note.—Milk, bread and butter served to all before retiring.

We learn from the report of Robert H. Halsey, attending physician of the Home, that the average period of stay of 28 children, who were suffering from cardiac disease so severe as to render them incapable of any physical exercises, was 53.75 days. It would appear, therefore, that period of treatment is shorter than that in our own residential schools of recovery. With

reference to the inadvisability of admitting those cases of advanced heart disease, Halsey expresses a definite opinion. "Over one half the number were no better at the end of the periods, some of which were 109 days, than on admission. . . . From an experience of these cases, carried over several months, it does not seem justified to expend the funds in this way when there are many children with less damaged hearts who can be definitely improved." Reporting on the general results of treatment, Halsey states:—"Of the children who had been at the Homes a questionnaire sent to the clinics from which they came showed the larger number were maintaining benefits."

Ordinary Convalescent Homes.

It is the considered view of experienced physicians that the ordinary convalescent home, which admits for the most part children who are recovering from the after-effects of acute diseases or surgical operations, is not in general a suitable place for children suffering from sub-acute or chronic rheumatism, chorea, or carditis. To quote Reginald Miller—"The ordinary convalescent home in the country or at the seaside is too happy and lively a place for the chronic heart case."

To mix the sensitive and nervous choreic child, or the cardiac child, whose disability may be profoundly affected by over-exertion, with children who, as convalescence proceeds, may exhibit a superabundance of energy and spirits is plainly to incur great risks. The nature and organisation of most convalescent homes does not permit of the strict supervision over medical condition, education and physical exertion of each individual child which is necessary for the successful treatment of rheumatism.

If certain wards are reserved for rheumatic and cardiac children, however, it is possible for ordinary convalescent homes to play an important part in their treatment, provided a competent nursing and consultant medical staff are available to superintend it. This involves a reorganisation always difficult, sometimes impossible, and which, in fact, converts part of the institution into a special residential home of recovery. That it can be done successfully is proved by the work carried out at the Horsfall Wards, St. Mary's Home, Broadstairs, described in the previous section. The matter is, however, gaining general attention, and similar arrangements are about to be made at the Heswall Convalescent Home, the county branch of the Royal Liverpool Children's Hospital.

Day Open Air Schools.

The regimen and curriculum of the Day Open Air School are designed for the treatment and education of children suffering from temporary and remedial conditions of ill-health. The School seeks to provide special nutrition and life in the open air and sunlight, combined with a curriculum specially adapted to the needs of the children in attendance, so as to enable the "delicate

child " to regain sufficient strength and vitality to allow his return to the ordinary public elementary school after a period varying usually from 6 months to a year, but in some cases extending to two or three years.

Children selected for admission to this type of school fall into four main groups :—

- (a) Those suffering from ill-defined conditions of bad health, such as malnutrition, anæmia, debility, the " pre-tubercular " conditions, and rickets.
- (b) Those convalescent from acute diseases or surgical operations.
- (c) Those with enlarged glands, tubercular or otherwise.
- (d) Nervous or highly-strung children.

The buildings are of various types, from the temporary wooden shelters placed in public parks or open spaces to the specially erected schools providing class-rooms, which can be opened on three sides, a dining-room, a rest room, bathrooms, and the necessary offices. Often a private house is used as an administrative block, while in the grounds surrounding it are built wooden sheds which serve as class-rooms.

In schools assembled in temporary shelters often there is no heating apparatus, or at the most a stove which serves only to dry the air in its immediate neighbourhood. For the maintenance of warmth reliance is placed on adequate and proper clothing and a judicious interspersing of physical exercises among the sedentary occupations of the curriculum. In some newly erected buildings has been installed an efficient system of under-floor heating consisting of hot-water pipes embedded in concrete beneath a floor of special composition. In schools having a permanent building as an administrative block arrangements should be made for a room in which children can dry their clothes. In all schools it should be possible to provide a change of stockings and shoes for children who have got wet in their journey from home.

The regime of the day open-air school follows more or less standardised lines. The children assemble at about 9, when a light breakfast, usually consisting of milk and bread and butter, is served. Two hours' instruction in the usual school subjects is given in the morning, with a break for physical exercises or games. The mid-day meal is served between 12 and 1. This is followed by one and a half hours' rest, taken on flat canvas stretchers or trestle beds in the open air, or during inclement weather in the rest shed. The afternoon session, which is usually devoted to hand work, again lasts two hours. In most schools milk is served before the children return home between four and five in the afternoon.

Instruction, even in theoretical subjects, as far as possible takes a practical form, and is given in the open air.

The general arrangements of the day open-air school are under the supervision of the school medical officer or his assistant.

He is responsible for the admission and discharge of cases. He draws up the dietary, and advises on the adjustment of the curriculum to suit the disabilities of individual children. All children are examined by the school medical officer at frequent intervals and by the school dentist at least once during their period of attendance. A school nurse is in attendance for the whole or part of her time. Her duties include the supervision of the personal hygiene and cleanliness of the children, of bathing and of meals, the treatment of minor ailments, and assisting the school medical officer during his visits.

The value of the day open-air school in the treatment of sub-acute and chronic rheumatism is still a matter of doubt. During 1925, the Board of Education addressed an enquiry to 30 school medical officers as to their practice and results in admitting rheumatic children to day open-air schools in their respective areas. Twelve replied that they did not admit such cases; of these, four, expressing an opinion based on experience, stated that such children do not do well under open-air conditions. Five do not admit children because of theoretical objections, and three, on account of lack of accommodation and pressure of other cases. On the other hand ten out of the 30 school medical officers reported that slight cases of chorea might benefit by attendance. Four school medical officers of areas of such diverse climatic conditions as obtain at Kettering, Newcastle, Tynemouth and Torquay stated that children suffering from various types of chronic rheumatism have attended their open-air schools with beneficial results, while the school medical officer of Nottingham, though admitting such cases, writes, "they obtain little or no benefit until the septic focus (tonsils, etc.) has been found and adequately dealt with."

From such conflicting evidence it is difficult to draw a conclusion. Experience appears to indicate that cases of rheumatism which are prone to relapse, *i.e.*, where the infection is still active, of severe carditis, and of severe chorea are not suitable to attend day open-air schools. In the admission of cases of slight chorea or rheumatic carditis, in which the disease is quiescent, due regard must be paid to the climatic conditions of the area, the site and hygienic state of the school buildings, the distance of the school from the home, and the home conditions of the child.

Residential Open Air Schools.

The types of cases treated at the residential open air school differ in no essential from those admitted to the day open air school. The general regime (except in so far as the children sleep and have all their meals in the school), the school curriculum, and the arrangements for medical supervision follow closely the description given in the previous section.

Suitable premises are usually secured by the adaptation of private houses with grounds in which can be erected open air class-rooms. The house is used as the administrative block, and

in it is usually found suitable accommodation for dormitories, a dining-room and play-rooms.

Certain advantages accrue from the fact that the school is residential. As the question of distance or accessibility need not be considered, the site can be chosen with stricter regard to suitability of position and healthiness of surroundings. The school may be situated in the heart of the country or at the sea-side. The children are under stricter regime, and are not returned every night to unfavourable sleeping quarters and domestic environment, which too frequently is the case with those in attendance at the day open air school.

Nevertheless, the ordinary residential open air school, like the day open air school, is not altogether suitable for the rheumatic child. They combine the liveliness of the ordinary convalescent home with certain characteristics of the day open air school which are not suitable for him.

Special Schools for Physically Defective Children.

Special schools for physically defective children provide education for those who through chronic disease or severe deformity are unable to obtain proper benefit from attendance at the ordinary public elementary school. The types of children selected for admission are those suffering from non-active tuberculosis of the bones or joints, paralysis due to various causes, the most important of which is poliomyelitis, severe deformities, usually congenital or due to rickets, and finally cases of severe heart disease or chorea.

Every child must be medically examined prior to admission to the special school and a certificate given to the effect that the child is by reason of physical defect incapable of receiving proper benefit from instruction in an ordinary public elementary school, but is not incapable by reason of such defect of receiving proper benefit from instruction in a special school.

The curriculum of the special school provides instruction in elementary subjects and in manual training. It is designed to stimulate the child's interest in life, and in some instances to train him in a vocation which he can follow in spite of his disability. Further special consideration is given to the needs of the child who, through prolonged absence from school, is retarded. Instruction is for the large part individual. Authorities are empowered to maintain children in the special school until the expiry of their 16th year, and there is accordingly opportunity to develop manual instruction along vocational lines.

As children may live at some distance from the school, arrangements are made for the conveyance of the children by ambulance. A mid-day meal should be provided. This not only overcomes the difficulty of frequent transport between home and school, but provides the children with a suitable and well-balanced dietary, which may be regarded as an important adjunct in the treatment of their condition.

The children are subjected to special medical supervision. A school nurse is in attendance to supervise the transport, to superintend the mid-day meal, to adjust dressings and splints, to carry out treatment of minor ailments, and to refer cases needing special or immediate attention to the medical officer. Frequent visits are made by the medical officer to supervise the general arrangements of the school, and to regulate the curriculum to meet the needs of special children.

The arrangements for the supervision of the careers of cripple children who have left the school are in the hands of an After-Care Committee. Their duties are to supervise the cripple during the early years of adolescence, and to assist in securing employment, or further education at the expiry of school age.

The place of the school for physically defective children in the treatment of cases under consideration is therefore more rigidly defined than that of the ordinary convalescent home or of the day open-air school. These schools provide for the results of our failure in the prevention of rheumatism and its complications. Such are cases of definite cardiac crippling, whose disability not only lasts through school days, but leads, too frequently, to a life of chronic invalidity and unemployment. Recent advances in public health should, however, profoundly modify the need for physical defective schools and the type of case admitted to them. The incidence of rickets has been lowered. The development of orthopaedic schemes under the maternity and child welfare and school medical services has enabled many a child, who formerly would have been admitted to a special school, to obtain full benefit from education at the public elementary school. Hence, unless similar comprehensive measures for the prevention of rheumatism and its complications can be evolved, the schools for physically defective children will admit an ever-increasing proportion of cardiac cripples in the future.

The Domiciliary Treatment and Supervision of Children Suffering from Sub-acute or Chronic Rheumatism.

Thus far we have dealt only with the institutional treatment of sub-acute and chronic rheumatism and carditis, and the function of certain special types of school in the care of children suffering from these conditions. We must now briefly consider certain other agencies which take part in the general supervision and domiciliary treatment of rheumatic children.

(a) *The General Practitioner.*—It is not possible to over-estimate the importance of the part taken by the general practitioner in the treatment and care of the rheumatic child. It is he who is first in a position to discover the predisposition to the condition and to advise on medical treatment and general hygienic measures necessary to minimise the chance of an outbreak of the disease. In many cases it is he who treats the acute stage of rheumatism, or advises institutional treatment. Finally, it is he who in many cases must supervise the after-care of the patient, advise on the

resumption of school life, and later advise on the choice of employment. The practitioner is thus in an advantageous position to exercise constant supervision through childhood and adult life in cases of rheumatism and heart disease.

(b) *Out-Patient Departments of Hospitals.*—The work of the out-patient department of one great general hospital has already been discussed in Section VII, and although this out-patient department is a most efficient one, the difficulties of the treatment of rheumatic children at home have been shewn to be considerable. Nevertheless, the out-patient departments of hospitals perform two functions with respect to the treatment and prevention of rheumatism and heart disease in children. They act as a “sorting house,” dividing up cases into those needing in-patient treatment for the acute stage, those who should be sent to special residential schools of recovery, and those needing out-patient supervision. It is in regard to the latter, who may or may not have been treated in a hospital or special school of recovery, that they exercise their second function, that of treating and supervising children during the quiescent stage of the disease. This stage may be present many years and during it the possibilities of relapse are always present. To advise on how to prevent a recurrence, to keep the patient under periodic and frequent supervision, and to provide surgical treatment for those conditions, such as diseased tonsils and adenoids, which may lead to a relapse, are important activities, which are properly undertaken by the out-patient department of a hospital.

The results of two years’ working of such a clinic at the Royal Hospital for Sick Children, Glasgow, have recently been published,* the general conclusion being: “That by the establishment of a clinic of the kind described rheumatism in the children supervised can be controlled, and the incidence of carditis reduced to a minimum.”

Similar clinics are held in Paddington, Birmingham, Liverpool, Bristol, Manchester (Ancoats Hospital) and other areas.

(c) *The Work of Voluntary Care Committees.*—The work undertaken by the Invalid Children’s Aid Association in London, in not only providing two residential schools of recovery, but also in following up by visits from their voluntary workers, or children who have been discharged, has been described in a previous section. The Manchester Branch of the Association keep a register of rheumatic children, visit them and refer them to the special clinic at the Ancoats Hospital. Children’s Care Committees are in operation in many centres, among which may be mentioned London, Birmingham, South Shields, Somerset, Surrey, Essex and Herefordshire.

(d) *The Work of the School Medical Service.*—We can but briefly touch on the work of the school medical service with regard

* Brit. Med. Jour., May 8th and 15th, 1926. (On the Control of Heart Disease in Childhood, by Margaret F. Lowenfield, M.R.C.S., L.R.C.P.)

to the treatment and supervisory care of cases of rheumatism and carditis in children. It plays an important part, and in future will play a still greater part in any comprehensive scheme of prevention and treatment. Poynton, in his Bradshaw Lecture* in 1924, stated: "The period of school life is by far the most important in the history of acute rheumatism in this country. . . . It follows, therefore, that the school medical service must take an ever-increasing share in the problem of prevention."

The Chief Medical Officer, in his Annual Reports for 1924 and 1925 to the Board of Education, suggested the lines of action which should be taken by Local Education Authorities. They are as follows:—

(i) *A Rheumatic register*.—"The school medical officer should establish a register of all the children suffering from the principal manifestations of rheumatism (cardiac disease, chorea, or arthritis). Such children should be individually studied and kept under periodic supervision."

(ii) *Education of the parent and the public*.—Generally speaking no public health measure can be really effective unless the public are sufficiently enlightened to demand its fulfilment.

This is as true of the prevention of rheumatism as it is of the control of any other disease. Education of the public, and particularly education of parents and school teachers, concerning the dangers of the disease, must be one of our main lines of defence against its ravages. The distribution of leaflets (as at Bristol) describing the early signs and emphasizing the need of skilled medical attention is important.

iii. The proper nutrition and clothing of the child in attendance at school, and the effective sanitation and dryness of the school premises.

(iv) *Exclusion from school for particular cases*.—Due consideration must be given to the medical condition of the child, his home circumstances, the distance of the school from the home, and the hygienic state of the school, in deciding whether exclusion is the best course to pursue. Special consideration must be given to the amount of physical drill, and games, which should be allowed to cases who continue at school.

(v) *After-care*.—"The school medical officer should also advise in regard to the home and social environment of the rheumatic child, its after-care, its upbringing and employment."

It is along lines such as these that the school medical service is working. In many areas all the suggestions described above have been adopted; and in all there is provision for the periodic examination of ailing children, among which may be included the rheumatic and cardiac, and for the treatment of special defects.

In certain areas again, research into the etiology of rheumatism is being carried out. The influence of environmental and climatic

* Brit. Med. Jl., Nov. 29th, 1924.

conditions, the nature of the soil, and the existence of special defects such as tonsils and adenoids and dental disease, on the production of rheumatism, offers a wide field of research, which the school medical officer has a unique opportunity to enter.

(vi) *Treatment of diseases associated with rheumatism.*—Sufficient has been said concerning the pathological conditions common among school children, which are predisposing factors in the production of rheumatism, to indicate the direction which preventive treatment should follow. By arranging systematic inspection and treatment of diseases of the teeth, nose and throat, the school medical service may do much to diminish the incidence of rheumatism. Indeed, it is probable that these special branches of the service have already affected, if not the incidence, the type of disease. The severe type of rheumatic infection and great constitutional disturbances are now less frequently seen in children and the percentage of hospital patients suffering from acute rheumatism has been reduced in recent years.

X.

Co-ordination of Measures for the Prevention and Treatment of Rheumatism and Heart Disease in Children.

We have described the part taken by hospitals, certain types of special schools, the practitioner, the public health services, and voluntary Care Associations in the campaign against rheumatism and rheumatic carditis in children. But equally essential is the efficient co-ordination of these activities to produce a comprehensive scheme of treatment, research, and after-care.

This effective co-ordination is a matter of great difficulty everywhere, but the difficulty will vary greatly with the circumstances of each authority. It will probably be most practicable in such an authority as a County Borough where the same authority is responsible for both public health and school medical services and has hospital beds at its disposal.

(a) The first essential is that the school medical officer should establish a register of all children suffering from the principal manifestations of the rheumatic infection. Such children will be divisible into two main groups, first those for whom it will be sufficient that they should be regularly observed and supervised by the officers of the school medical service, and secondly those whom it will be necessary to send to the treatment unit (which will usually be at a children's hospital, but sometimes at a general hospital) for diagnosis and treatment. Here cases of carditis detected at the routine medical inspection at schools will be referred for special examination (when necessary) by cardiographic methods.

Accurate diagnosis is difficult in the circumstances of routine school examinations, and there is need for this further examination,

for whilst a majority of cases may be easily diagnosed there is yet a large percentage of cases where a further examination by a specialist is essential to avoid on the one hand the disaster* of stigmatising a child as "cardiac" who has some bruit or heart irregularity which is purely physiological, and on the other hand the less frequent mistake of not recognising in time early signs of progressive cardiac infection.

(b) The functions of the out-patient department in relation to the treatment of rheumatism have already been described. It is the "sorting house" of cases, which may be grouped into those requiring in-patient treatment, those who should be admitted to a residential home of recovery, and those who are in need of merely periodic supervision. It should be organised as a "rheumatism centre"† to which all cases needing treatment, either institutional, or domiciliary, may be referred by the school medical service, the practitioners, the public health service (if notification be adopted) and the voluntary associations.

The services of the public health and school medical nursing staffs, and of the voluntary workers of care committees should be utilised to secure the regular attendance of patients at the centre at definite stated intervals, and the periodic supervision and after-care of children who are being treated in their homes, or have returned after discharge from an institution. All such work should be co-ordinated by the "rheumatic centre" working in closest co-operation with the school medical officer.

(c) The hospital is the place for treatment of acute cases of rheumatism, including carditis and chorea. If practicable, a sufficient number of beds should be available for such cases, to ensure that treatment may be so prolonged as to minimise the risk of a relapse when the patient is transferred to a residential school of recovery. Here those cases requiring tonsillectomy should be operated upon; under ideal conditions the rheumatic child would always be admitted for the operation, and whilst to insist upon this condition in every case might do harm by delay, there will always be certain selected children who must necessarily be admitted for the operation.

* Dr. Askins (Bristol) has kindly communicated the results of a series illustrating the fact that this difficulty occurs even with a highly efficient school medical service. 212 children considered to have organic heart disease at routine school medical examination were re-examined at the heart departments of two general hospitals. Of these 132, or 62 per cent., were cases of rheumatic heart disease; 56, or 26 per cent., had cardio-respiratory and exocardial signs only, and 48, or 23 per cent., required no treatment; 22, or 10 per cent., were cases of congenital defect of the heart; 11 of these, or 5 per cent., requiring no treatment.

† The ideal of the scheme should be the prevention of the rheumatic infection *before* carditis has ensued, and although this ideal is as yet unattainable, it is wise in name and in mental attitude to emphasise that it is a "rheumatic" and not a "cardiac" centre, and that the patients are rheumatic rather than cardiac children. This is emphasised in the Report of the Sub-Committee of the British Medical Association, British Medical Journal, April 16, 1927 supplement, p. 123.

Of no less importance is the function of the hospital as a centre for research in the treatment and prevention of rheumatism and heart disease, and in areas where research is possible concentration of beds by the formation of a rheumatism ward or unit may be advisable. Biochemical and bacteriological problems can be undertaken by the scientific staff, the influence of special defects can be investigated by the specialists engaged on these diseases, and the effect of home and environmental conditions by the nurses and health visitors.

(d) The next most important link in the chain is the special residential school of recovery, which admits cases, convalescent after the acute attack, or cases of more insidious onset and symptoms. Without it we cannot hope to ensure a sufficiently prolonged convalescence as will build up the patient's resistance to the infection, lessen the chance of a relapse, limit the extent of the lesion once heart disease has begun, or re-educate a damaged heart to perform its normal function. Adequate provision in this respect is therefore essential in a successful scheme for prevention and treatment.

(e) On discharge of a patient from the hospital or special residential school of recovery, supervision and *after-care* should be continued by the "rheumatism centre." If the treatment has been successful the patient is returned to the public elementary school ; if unsuccessful he is admitted to the school for physically defective children. In either case he will be under the supervision and care of the school medical service, the activities of which must be intimately linked with those of the "rheumatic scheme."

(f) Finally, there should be efficient liaison between the "rheumatism centre" and the certifying factory surgeons and the Juvenile Employment Bureau, by which employment suited to the limitations of each cardiac child may be secured.

For the efficient working of such a scheme unity of purpose and control is essential, therefore, its manifold activities should be co-ordinated by one man, of acknowledged skill and consultant standing, on the staff of the hospital and acting as expert adviser to the school medical officer. He should be in charge of the centre and of all the arrangements for the treatment at the hospital and at the residential school of recovery, and of the after-care of the patient. His advice should be sought with regard to the curriculum and general care of patients at the school for the physically defective, and to the choice of vocational training with a view to special employment for those with serious cardiac disability.

NUMBER OF BEDS REQUIRED.

A sufficient number of beds in hospital for the acute stage (3 to 12 weeks) and a larger number of beds in an appropriate special institution for convalescence and recovery are essential for the success of any scheme. Concentration of cases is desirable for facility of treatment but still more for facilities for research.

What this number of beds should be we have as yet little

experience. The American Society for the Relief and Prevention of Heart Disease* (now united to the New York Tuberculosis and Health Association) suggested that as a rule for large city populations one convalescent heart bed was necessary for every 10,000 population, one-fifth of the beds being for adults. Buchan† estimates on "theoretical and perhaps disputatious considerations" that six beds for rheumatic fever and heart disease should be provided for a population of 100,000, an estimate less than two-thirds of the American.

These two estimates, which are for all ages, are based upon general population. Kerr‡ bases his estimate for school children upon school population, and considers that there is urgent need of residential accommodation equal to one and a-half beds for every thousand children on the roll.

The second report of the Sub-Committee of the British Medical Association on the Prevention and Control of Rheumatic Infection in Children (published in the Supplement of the "British Medical Journal," April 16th, 1927) deals largely with this subject of co-operation. The report contains many points of interest. It is prefaced by two preliminary considerations which, in the sub-committee's view, are of such moment that their acceptance is of fundamental importance for the right understanding and correct handling of the problem of juvenile rheumatism. They are :

First, the problem of rheumatic heart disease in children is the problem of a systemic infection, not of a static disease of an important organ ; in other words, every case of rheumatic heart disease in a child is primarily a rheumatic rather than a cardiac problem, and is, therefore, one for consideration on the broadest principles of medicine.

Secondly, this being so, the medical care of such children should be left to those who have immediately at hand the means of treatment for any and every rheumatic condition or emergency—that is to say, to practitioners (where means permit) or to hospitals, rather than to any *ad hoc* institutions or clinics which are divorced from facilities for dealing with the serious infective problems that may arise at any moment in rheumatic children.

In the report itself the sub-committee again draw attention to the importance of the housing factor, especially of dampness, in the production of rheumatism which they emphasised in their first report.

They make suggestions with regard to modified school attendance for children medically certified as rheumatic ; increased medical inspection ; the prevention of children sitting in school in damp clothes or boots ; and special medical supervision of rheumatic children which, in their opinion, should be conducted rather by the general or children's hospitals (by means of a "Rheumatic Register" kept by the Almoner, or by the establishment of a "Rheumatic Supervisory Centre") than by the school medical service and its clinics. The sub-committee are not in favour of setting up special "Rheumatism Treatment Clinics" to which all rheumatic cases would be drafted for treatment, nor of the establishment of "cardiac clinics." (The differences in method implied by these various terms are explained in appendices to the sub-committee's report, and it is not possible here to do more than refer the reader to the actual report.)

They emphasise the fact that the provision of beds for cases requiring

* R. O. Moon, Brit. Med. Jl., 1923, June 2nd, p. 923.

† Proceedings, R. Soc. Medicine, 1927, p. 209.

‡ Kerr. "The Fundamentals of School Health," p. 295.

many months of rest and treatment is beyond the scope of most ordinary voluntary hospitals; nor are these the ideal places for such treatment. This must be undertaken by Rest Homes, to be worked in closest co-operation with the hospitals. The report discusses the lines upon which the sub-committee consider these Rest Homes should be provided—co-operation with the “parent” hospitals, and combination, for administrative purposes, with hospitals in which the other crippling diseases of childhood are received, being recommended.

The sub-committee consider the provision of Rest Homes on the indicated lines to be an immediate necessity in all large towns.

EXAMPLE OF SCHEMES IN OPERATION.

The best example of a scheme for the treatment and prevention of rheumatism actually in operation at the present time in England is that in Birmingham, to which reference has already been made on p. 76. All rheumatic children discovered in the course of routine medical inspection in the schools are reported to the Rheumatism Bureau at the Children's Hospital as cases needing supervision, or the advice of the consultant. If acutely ill they are admitted to the Children's Hospital for a period which may include treatment at the Moseley Hall Convalescent Hospital for Children. When convalescence is established they are sent to Baskerville Residential School, which has 94 beds. The sub-acute and chronic cases are placed on a waiting list for the Baskerville Residential School, or referred for periodic examination by the consultant. The cases needing supervision are visited by nurses or examined by medical officers of the Education Authority. There are a certain number of cases attended by private practitioners, which are not necessarily covered by this scheme. The only intimation which the Local Education Authority receives of such cases is either through the school attendance officers, or through voluntary notification by the private doctor. When such information is received the practitioner is communicated with, and invited to avail himself of the services organised by the “rheumatism bureau.” After discharge from Baskerville the case is reported to the School Medical Officer of Birmingham, and its after-care and supervision is undertaken by the nurses and medical officers of the Education Authority working in close touch with the “rheumatism bureau,” or in special cases by the consultant himself. Supervision is continued until school-leaving age, when the medical history, and disability, if any, is reported to the juvenile employment bureau.

Here is, in fact, an almost complete scheme which is linked in close and effective liaison, nominally by the “Rheumatism Bureau,” but actually by the willing and close co-operation of many persons and committees. The whole work is co-ordinated and controlled by a specialist, who is consultant to the Children's Hospital and Baskerville Residential School and also a medical officer of the Education Committee.

In London the position has been lucidly described by the County Medical Officer,* but the difficulties compared

with those of Birmingham, are considerable. The metropolitan local health authorities are 29 in number, differing from each other in view and in method, entirely distinct from the numerous boards of guardians (who provide the infirmaries containing approximately one-half of the in-patient accommodation for the cases of rheumatism in children), entirely distinct again from the County Council, who as education authority, are responsible for the school medical services, and distinct again from the Metropolitan Asylums Board, who provide the fever hospitals. Then again there is the legion of voluntary hospitals and children's hospitals, and the many branches of the Invalid Children's Aid Association. Clearly co-ordination here is both more necessary, and more difficult, than elsewhere. The problem is being approached from several different angles. At the request of the London County Council, the Metropolitan Asylums Board have already provided a special research unit of 60 beds in their Queen Mary's Hospital for Children at Carshalton. Here it is intended to receive children in the acute stages of the disease at the very earliest opportunity. Cases are specially selected partly in the out-patient departments of several of the large London hospitals and partly by the school medical service. Bacteriological investigation is being carried on in these acute cases in a special laboratory which the Metropolitan Asylums Board have provided at the hospital, this investigation being at present mainly concerned with researches into the problem of immunity.

In addition, the Metropolitan Asylums Board reserve 16 convalescent beds at Carshalton for rheumatic cases sent by the school medical service, and they have just allotted a further 56 beds at High Wood Hospital for Children, Brentwood, for the same purpose. At the Downs Hospital the Metropolitan Asylums Board have, on an average, some 80 beds always filled with similar cases sent to them in a stage of convalescence from Poor Law infirmaries. The Board's recent decision, at the request of the London County Council, to extend their Queen Mary's Hospital for Children at Carshalton by building further accommodation for about 350 London children with rheumatic disease, will place London in a much more favourable position in this respect.

The two Homes of the Invalid Children's Aid Association have been earlier described. Regulations have recently been issued making acute rheumatism in persons under the age of 16 temporarily a notifiable disease in the Metropolitan Borough of Paddington, and a "rheumatic supervisory centre" has been established at the Paddington Green Children's Hospital.†

* London County Council. Report of the Medical Officer, 1925, p. 127.

† The admirable "Parents Paper" used at this centre, organised by R. Miller, shortly explains the methods employed, and is reproduced as an appendix, p. 99. The suggestions on the care of rheumatic children are based upon those of F. J. Poynton, *Brit. Med. J.*, 1923, Vol. I., p. 920.

XI.

Summary.

The statements which follow are not advanced as "conclusions" or as proved by the subject matter of the Report. Our knowledge of the aetiology and our experience of the results of the treatment suggested are alike too limited and imperfect to permit of any "conclusions" in the strict sense. Nevertheless it may be convenient to summarise here what appears to be the present position.

1. A large proportion, probably not less than 40 per cent., of all deaths from heart disease are of acute rheumatic origin.

2. Two-thirds of the acute rheumatic infections which ultimately cause these deaths are contracted in the period of childhood 5-15.* The younger the age of infection the more likely is the heart to be affected. From puberty onwards this risk of heart damage gradually lessens. Girls are more susceptible to chorea and to rheumatic carditis than are boys. This increased susceptibility of girls is also seen in rheumatic fever (arthritis), but to a less extent. The findings of the Ministry's investigation (Report No. 23, page 66) shewed that young insured females were more liable to acute rheumatism in the proportion of 5 to 3, than young insured males, and that the proportion of cases shewing carditis was also greater in young insured females than in males.

3. Acute rheumatism is probably a chronic progressive infection which may remain latent for years. Recrudescences or recurrences, therefore, are characteristic, though they may be long postponed.

4. Whilst the infectivity of acute rheumatism is usually of a low grade, it is common to find two or more children of the same family infected, and this aspect of the disease deserves increased attention from the preventive side. The strong probability that the infection often enters the system through the tonsils increases the probability that the risk of infection is increased by intimate contact in unsatisfactory environment.

5. Attack confers no immunity but rather creates liability to further attack. Years must elapse before the patient can be regarded as free from risk, years during which a wise but continuous watch must be kept over him. Even in cases in which the recurrence cannot be averted, the longer the interval and the older the child the less is the risk of permanent damage ensuing. Every effort to avert recurrence therefore, is worth while even if not crowned with complete success.

6. Poverty and urbanization are potent predisposing factors. In cities particularly, dampness of the house appears to increase the susceptibility of the individual to attack, although this point proves extraordinarily elusive when investigated.†

* Carey F. Coombs. "Rheumatic Heart Disease," 1924, p. 17.

† For the discussion of these aetiological factors the reader is referred to the Medical Research Council's Report: "Social Conditions and Acute Rheumatism."

7. Though many experienced observers consider the bacteriological cause of acute rheumatism to be a streptococcus of the Viridans group, and though no rival theory has so far made substantial headway, we have as yet no certain knowledge as to the causal organism. Attempts to identify rheumatic strains by serological tests have failed. More research work, including the elaborate methods of combined chemical and serological analysis, which have been employed in connection with pneumococci, is urgently needed.

8. In the absence of certain knowledge as to the causal organism, it follows that our efforts at prevention must still be empirical, and that we must grope our way more or less in the dark until the new light comes. Nevertheless clinical experience indicates which way the road to prevention lies. As regards the many minor manifestations of the rheumatic infection, Haven Emerson* says, that prevention lies in "Cleaner mouths, fewer diseased tonsils, fewer neglected decayed teeth, earlier recognition of sore throats, and quick care in their treatment as serious infections, the considered and skilled attention to the little child with aching muscles and joints—'too young to have rheumatism,' kept up and about with 'growing pains'—repeated examinations of the heart after attacks of any acute infectious fever in childhood, always separation of the sick from the well; by such means will the number of acute rheumatic hearts be reduced."

We may fairly say that one child in every fifty attending public elementary schools in cities and towns requires observation and periodic examination on account of manifestations of rheumatic infection and the danger they imply to the heart. In some the attack is obvious, in others insidious.

9. With regard to the major manifestations of the disease, *i.e.*, when once the child has sustained an attack, clinical experience again has clearly shewn us that to minimise the risks of permanent damage to the heart and of recurrence at some future date the child requires: (a) full in-patient hospital treatment for a period of six to twelve weeks during the acute stage of his illness, and (b) special convalescent treatment and after-care for a further period of at least six months. The child may also require surgical treatment for the removal of foci of septic infection.

10. Special institutional treatment is intended to prevent the carditis almost invariably present in rheumatic cases from causing permanent damage, by furnishing, first, a period of complete rest, and secondly, after a period of complete cessation of symptoms, a slowly graduated resumption of activity, both periods being spent in an environment as favourable as possible so that the patients' resistance may be raised to the highest of which it is capable. Special education is required for convalescent rheumatic children at these institutions.

11. The removal of focal sepsis is essential to success in pre-

* Survey Graphic, VI, November 2nd, 1924.

vention as in treatment. Tonsillectomy, performed early and completely, is therefore of great importance, although it is not always entirely effective. When the child has already had attacks of acute rheumatism, complete tonsillectomy will not in every case prevent recurrence (especially of chorea) or progressive cardiac involvement, but in suitable cases it appears to be one of the most valuable means to these ends that we possess.

Tonsillectomy cannot diminish infection which lies deeper than the tonsils, but it cuts off the enemy from his port of entry and from "a base of supplies," and by preventing reinforcement allows the patients' resistance to the infection a fuller opportunity of success. Even in cases of chorea, tonsillectomy, although it seems to have no practical effect in preventing the recurrence of chorea, may be well worth while as tending to prevent progressive heart trouble.

12. In addition to the continuous supervision of children who from minor manifestations are suspected of infection, the periodic re-examination of recovered patients is essential. Supervision should at least continue until the patient is full grown and settled in some suitable employment.

13. Section VII dealing with the out-patient treatment of rheumatic children at home shows that the kind of rest which is essential to the treatment of rheumatic carditis, in its active stage, is unattainable in the ordinary home circumstances of the working classes. It seems clear that, without further institutional accommodation, the most carefully co-ordinated schemes of prevention of rheumatic sequelae will fail to prevent them. To determine the size of the special institution necessary, a standard of six beds per 100,000 general population may be suggested provisionally, though probably the American standard of 10 beds to 100,000 general population (8 for children, 2 for adults) may ultimately be found necessary.

14. "The gain of a single day in the treatment of endocarditis," said Latham, "is a gain indeed." Viewed in this light the numerous cases in the Report where children have to wait months for a vacancy, or still more the 77 per cent. of children who received no institutional treatment, are each of them a challenge. Have we promptly applied to these cases the knowledge now existing in a reasonable way and to a reasonable extent?

15. Lastly, co-ordination of effort is essential and can only come through sound organisation and good will. Parents, teachers, school nurses and doctors, medical officers of health, practitioners, physicians, bacteriologists, throat surgeons, cardiologists, education authorities, almoners, hospital committees, after-care committees, have all important parts to play. To induce so diverse a crew to pull together is indeed to be an administrator. "This," said Osler, "is the difficult problem; making this knowledge effective; getting sense and getting wisdom . . . there are three to educate, the public, the profession and the patient."

Parents' Paper.

PADDINGTON GREEN CHILDREN'S HOSPITAL.

(Incorporated.)

RHEUMATISM SUPERVISORY CENTRE.

(FOR RHEUMATISM, ST. VITUS'S DANCE, AND RHEUMATIC HEART DISEASE.)

*The Centre is open every Saturday. Admission (free)
1 to 2 o'clock p.m.*

The object of the Centre is to keep a watch over your child, so as to prevent it from getting a fresh attack of rheumatism, or developing heart disease, without your knowing that anything is wrong.

The chief danger of rheumatism in children is heart disease, and this may develop so quietly that it can only be detected by a doctor's examination. The Centre offers you the opportunity of having your child's heart examined periodically with a view to preventing its becoming affected.

The Centre is not a treatment clinic, and will not interfere in any way with the treatment from the hospital or private doctor who usually looks after your child. It is intended to help you to take the best care of your child while it is apparently well, and to warn you as early as possible of any symptoms requiring medical attention.

A card will be sent to you to remind you when your next visit is due ; but if you are in any doubt or difficulty about your child, you can bring it to the Centre on ANY Saturday.

If the child becomes ill, do not wait for the Centre to be open, but obtain advice at once from :

(Name of Practitioner or

Hospital Physician).....

(Address).....

YOU SHOULD READ THE SUGGESTIONS OVERLEAF.

(Reverse.

ON THE CARE OF RHEUMATIC CHILDREN.

1. Rheumatism is caused by infection by a germ, and it is a common disease of children, in whom it often attacks the heart. This is the great danger of the disease. Rheumatism is the commonest cause of heart disease in children.

2. Rheumatic attacks of all sorts often start with a sore throat. A sore throat in a rheumatic child is always a dangerous symptom.

3. Common symptoms of rheumatism in children are :

Sore throat.

Paleness.

Pains in muscles.

Shortness of breath.

Painful joints.

Fidgetiness or nervousness.

4. Choreæ, or St. Vitus's dance, is rheumatism attacking the brain. Its chief danger is the tendency for the heart to be injured at the same time. Unusual nervousness, disturbed sleep, fidgety movements, or a tendency to drop things, may be warnings of St. Vitus's dance.

5. Rheumatic heart disease is often painless and may only be discoverable by a doctor's examination.

6. If the heart has been injured by rheumatism, its recovery is very slow, and permanent harm may be done by letting the child resume an ordinary life before recovery is satisfactory.

7. An occupation in life for a child with heart disease requires very careful choice.

8. Rest is very necessary for rheumatic children. They should always be put to bed early, and they should be made to lie down during the day if they seem at all tired or if there is any aching of the limbs.

9. Damp is bad for rheumatism ; basements are dangerous. Rheumatic children should sleep in the sunniest and driest room available. If they get wet, their clothes should be taken off and dried at once. Water-tight boots are especially important.

10. Rheumatism tends to recur, especially in the winter months.

